FDM 11-50-1 Work Zone Policy Statement December 22, 2011

1.1 Work Zone Policy Statement

The Wisconsin Department of Transportation (WisDOT) is committed to promoting safety for the traveling public and workers, minimizing congestion and adverse traffic impacts, and providing for improved public satisfaction during construction, maintenance, utility, and all other activities performed on or near the WisDOT highway network. Compliance with this policy will reduce work zone crashes, travel time, and provide benefits to all stakeholders. All regional offices and statewide bureaus are responsible for implementing the portions of this policy affecting their operations.

1.1.1 Goals and objectives

The goals and objectives of this policy are to:

- Reduce crashes in work zones
- Provide a conducive environment for safety and mobility for workers and the traveling public
- Minimize work zone related delays not to exceed 15 minutes above normal recurring traffic delays between major city nodes and within each major city
- Provide traveler information to minimize delays and improve mobility, efficiency and safety
- Clearly define stakeholder responsibilities
- Develop work zone training for WisDOT staff
- Evaluate and continuously improve work zone safety and mobility performance.

1.1.2 Applicability

This policy is applicable to all work, including contracts for highway construction, railroad crossings, maintenance, and utility projects on state trunk highways, and Federal and State funded local roads improvement projects. These activities must have a Transportation Management Plan (TMP).

WisDOT will submit all TMPs to the Federal Highway Administration (FHWA) for their concurrence on all projects subject to federal oversight, both on and off the National Highway System (NHS) per the WisDOT/FHWA Federal-Aid Oversight Agreement. WisDOT must approve projects not subject to Federal Oversight, both on and off the NHS.

It is WisDOT's policy to consider work zone impacts in all phases of project development and construction. Incorporate specific mitigation strategies in the TMP during the project development process to address the characteristics of a particular project and its associated work zone impacts. Work zone data and annual project reviews will be used to evaluate work zone processes and procedures. The changes made to the TMP during construction will facilitate improvements at the project level and system-wide. Personnel involved in project development and construction should receive appropriate training periodically.

This policy supplements existing department wide policies, standards, guidelines, processes, and practices as detailed in the FDM, Standard Specification, Construction and Materials Manual (CMM), TGM, MUTCD, WisDOT supplement, etc. Refer to FDM 11-50-5 for TMP preparation process.

1.2 Responsibilities

1.2.1 Bureau of Highway Traffic Operations (BTO) and Bureau of Project Development (BPD) Directors and Regional Directors

- Advocate for compliance with TMP guidelines and lane closure policies, and approve corridor and project variances to established guidelines.
- Maintain awareness of the cumulative impacts of multiple projects along a corridor.
- Advocate for funding support for mitigation strategies included in TMPs.

1.2.2 Bureau of Traffic Operations (BTO)

Under the leadership of BTO, the Traffic Engineering Section is responsible for (in collaboration with other bureaus and regional offices) developing, setting, communicating, and updating work zone policies, procedures, and guidelines. These responsibilities include but are not limited to:

- Review of work zone TMPs, especially TMP type 3 and 4,
- Develop and maintain work zone traffic control standards and guidelines,
- Develop work zone traffic control specifications and standardized special provisions (STSP) in coordination with the Bureau of Project Development (BPD) and regional WisDOT offices,
- Review continually the effectiveness of work zones, improve and update work zone processes, procedures and policies to ensure quality and statewide consistency,
- Review and comment on work zone traffic control and mobility exceptions for TMP type 3 & 4,
- Develop work zone training program in cooperation with UW-Traffic Operations and Safety Laboratory (TOPS Lab) and UW- Transportation Information Center (TIC). The training program will provide appropriate levels of detail for supervisors, project managers, project leaders, inspectors, flaggers and workers,
- Review/approve speed zone declarations when reducing from 65 mph.

1.2.3 Bureau of Project Development (BPD)

- Review Design Study Reports (DSR) for work zone TMP and identified TMP type,
- Coordinate with BTO and Region for review of TMP types 3 & 4, and for exceptions to TMP and lane closure guidelines.
- Forward TMPs for Federal Oversight projects to FHWA division office for approval,
- Participate with BTO in reviewing work zone effectiveness and updating work zone processes and policies.

1.2.4 Regional WisDOT Offices

The project manager in collaboration with traffic operations at the Region is responsible for developing and implementing TMP. The TMP is developed according to TMP guidance, the Facilities Development Manual (FDM), Traffic Guidelines Manual (TGM), Manual on Uniform Traffic Control Devices (MUTCD), and other supplemental policies, directives, and applicable project specific contract documents including handbooks and special Traffic Control Plans (TCP).

1.2.4.1 Project Development Chief

- Support the consideration of work zone impacts and development of TMPs early in the project development process for all projects.
- Support coordination of TMPs along corridors and between adjacent regions and neighboring states.
- Support resource availability for TMP development, mitigation strategy measures and activities.
- Inform Regional Director of all projects with significant traffic impacts.

1.2.4.2 Operations Chief

- Maintain awareness of corridor and project variances that exceed the allowable limits.
- Maintain awareness of project-specific exceptions to work zone mobility policy.
- Advocate for resource availability for TMP development and strategies measures and activities.

1.2.4.3 Regional Planners

- Identify TMP type during scoping process in collaboration with PDS and Traffic Unit.
- Identify potential strategies in scoping document.
- Identify funding needs and issues associated with the TMP.
- Coordinate scheduling of projects to minimize repetitive construction projects or activities along a segment of roadway and to minimize conflicting projects on parallel/alternate routes.

1.2.4.4 Regional Traffic Engineers

- Provide input into type of TMP during scoping process.
- Provide input during TMP development, implementation and conflict resolution.
- Provide input for all traffic impact assessment and mitigation decisions during project initiation, scoping, design, construction and evaluation.
- Provide input on project reviews, approval, and modification of all TMP strategies.
- Verify that traffic control measures are in conformance with MUTCD, WisDOT Standard Detail Drawings (SDD), Traffic Guidelines Manual, WisDOT Standard and Supplemental specifications.
- Verify that traffic delays are minimized and do not exceed allowable limits. If exceeded consult with TMP team and / or project staff about possible modifications to the TMP.

- Review implementation plan with the project leader before construction.
- Verify with project staff that the contractor is complying with TMP as it relates to the handling of traffic.
- Review changes made by the contractor or project leader during construction.
- Review traffic control measures as needed to address field conditions pertaining to traffic flow, visibility, and safety.
- During TMP development review criteria in TGM 13-5-6 to determine if a temporary speed limit reduction is appropriate. If so, ensure that a tempoary speed declaration is completed prior to implementing the reduced limit.

1.2.4.5 Project Manager/Squad Leader

Project managers and staff will ensure appropriate action is taken to reduce work zone impacts to workers and the traveling public. Responsibilities include:

- Ensure project activities conform to the TMP,
- Designate a trained person at the project level, whose responsibilities include oversight of TMP implementation,
- Determine resource needs associated with the TMP development and implementation,
- Ensure traffic control measures are in conformance with MUTCD, WisDOT Standard Detail Drawings (SDD), WisDOT Standard and Supplemental Specifications and project-specific plans,
- Ensure contingency plans are implemented if necessary,
- Facilitate project reviews, approval, and modification of all TMP strategies,
- Ensure traffic delays are minimized and do not exceed allowable limits. If exceeded consult with TMP team or Regional Work Zone Engineer about possible modifications to the TMP,
- Verify contractor complies with the TMP as related to their performance of work,
- Review changes made by the contractor or project leader during construction,
- Notify Regional Communication Managers of significant project traffic impacts due to incidents.

1.2.4.6 Project Designer/ Leader

- Confirm scoping TMP type based on project needs and constraints,
- Develop content of TMP components, address mitigation and contingency plans based on needs of the project,
- Develop traffic control measures in conformance with MUTCD, WisDOT Standard Detail Drawings (SDD), Traffic Guidelines Manual, WisDOT's Standard and Supplemental Specifications,
- Minimize traffic delays during plan development, and ensure allowable limits are not exceeded. If exceeded consult with TMP team, Project Manager/Squad Leader or Regional Traffic Engineer/ Work Zone Engineer about possible modifications to the TMP,
- Notify Project Manager and Regional Work Zone Engineer of traffic impacts during TMP and TCP development,
- Develop contract requirements to ensure contractor complies with the TMP as related to their performance of work,
- Analyze changes requested or made by the contractor during construction,
- Work to ensure necessary TMP measures are planned and implemented by the contractor,
- Coordinate with nearby projects to minimize conflicting construction activities as needed,
- Coordinate with Regional Traffic Engineer/Work Zone Traffic Engineer to evaluate the TMP, highlight problem areas, successes and changes to the original TMP. A formal TMP follow-up evaluation report is not required on TMP type 1 & 2 projects but highly recommended on all TMP type 3 and required for all type 4 projects.

1.2.5 Other Stakeholders

It is advisable to have clear communication channels among all staff in the region to facilitate implementation of the Public Information and Outreach Plan (PIOP) and the Incident Management Plan (IMP).

- Regional permit personnel,
- Regional Maintenance personnel,
- Regional Utilities personnel,
- Regional Communications Manager,
- FHWA,

- Law enforcement
- Counties and local officials
- Industry

1.2.6 Contractor – Responsibilities

It is the contractor's responsibility to:

- Designate a trained person, whose responsibility is to ensure compliance with the traffic control plan and other contractual provisions related to the TMP,
- Ensure contractor personnel are trained in traffic control to a level commensurate with their responsibilities,
- Work with the project leader to ensure lane closures and / or disruptions to the traveling public are minimized according to the contract
- Perform quality control of work zones to promote consistency and ensure compliance with contract documents and guidelines,
- Recommend traffic control improvements to the project leader to address field conditions pertaining to visibility, traffic flow, worker, and motorist safety.

1.2.7 Law enforcement

Responsibilities for law enforcement include:

- Providing active and passive enforcement of traffic laws according to work zone law enforcement mitigation contracts, to promote safety and mobility in work zones,
- Identifying unsafe traffic conditions,
- Taking appropriate measures (in coordination with the project leader) to clear work zone incidents quickly,
- Understanding of work zone traffic control and operation and additional TMP components
- Documenting work zone incidents for future assessment of work zone impacts and process improvements.

FDM 11-50-5 Transportation Management Plan Process

December 22, 2011

5.1 Introduction

The Federal Highway Administration (FHWA) published a final rule on Work Zone Safety and Mobility in the Federal Register on September 9, 2004. The rule takes effect on October 12, 2007 and will affect all states and local governments that receive Federal-Aid Highway funding. The purpose of the update is to address changing times of more traffic, more congestion, greater safety issues and more work zones on our highways. These challenges require a systematic and structured approach to ensure traffic management consistency statewide. To meet these challenges the Rule requires development of Transportation Management Plan (TMP) for projects. For projects with lesser impacts, a Traffic Control Plan is sufficient to fulfill the requirements of a TMP. However, TMP elements should be documented in the Design Study Report (DSR). For projects with more significant impacts, additional TMP documentation is needed. The work zone policy statement in the Facilities Development Manual (FDM) FDM 11-50-1 addresses the department's goals and objectives as well as discussing where responsibilities lie when implementing the work zone rule.

5.1.1 Key Features of the Work Zone Rule

- The rule takes a policy based approach to institutionalize work zone processes and procedures, and,
- Emphasizes safety and mobility impacts of work zones.

5.1.2 How the Work Zone Rule Works

- It advocates for work zone considerations to be initiated as early as possible in the project delivery process,
- It underscores the adoption of policy and procedures that support systematic consideration and management (consistency) of work zone impacts,
- It encourages states and local governments to develop and implement strategies to manage impacts,
- It requires monitoring and assessing work zone performance, and,
- It encourages the use of work zone safety and mobility data to improve policy, processes and procedures.

This document underscores the need to take necessary and reasonable measures to minimize delays on high-

volume roadways while enhancing safety and mobility on all projects.

5.2 What is a TMP?

A transportation management plan is a set of coordinated transportation management strategies and describes how they will be used to manage work zone impacts of a road project. Transportation management strategies for a work zone include temporary traffic control measures and devices, public information and outreach, and operational strategies such as transportation operations and incident management strategies. The scope, content, and level of detail of a TMP may vary based on anticipated work zone impacts of the project. A Transportation Management Plan is required on all projects.

5.2.1 Purpose

The Wisconsin Department of Transportation (WisDOT) is committed to promoting safety for the traveling public and workers, minimizing congestion and adverse traffic impacts, and providing for improved public satisfaction during construction, maintenance, utility and all other activities performed on or near the WisDOT highway network. Compliance with this policy will reduce work zone crashes, travel time and provide benefits to all stakeholders. All regional offices and statewide bureaus are responsible for implementing the portions of this policy that affect their operations. For further details on the WisDOT policy, refer to FDM 11-50-1.

Maintaining safe flow of traffic through a work zone during construction should be planned and executed. Providing detours is often a better alternative, but, due to many reasons, it is frequently impractical and flow of traffic is maintained through the work zone. Sometimes traffic lanes are closed, shifted, or encroached upon in order to undertake construction. A transportation management plan must be developed to minimize the effect on traffic operations by providing adequate layout of traffic control devices and minimizing the frequency or duration of interference with normal traffic flow.

This document establishes guidelines for developing TMPs for all highway construction, street maintenance, and utility or construction activities performed by WisDOT, municipalities and other agencies.

Managing traffic is a continuous process that requires monitoring and updating the TMP as traffic flow or construction scheduling changes. Review the TMP at project completion to determine its effectiveness and incorporate lessons learned in future projects.

An effective TMP generally addresses project and site specific issues; with traffic impact analyses performed in accordance with WisDOT's Facilities Development Manual (FDM), Traffic Guidelines Manual (TGM), Manual on Uniform Traffic Control Devices (MUTCD) and other supplemental policies or directives.

Notify stakeholders about potential impacts early in the project initiation process to seek input and buy-in for the project. Larger projects may require the formation of a TMP Team to facilitate coordination and smooth project delivery. If a TMP Team is required, as determined by the regional project scoping team, it's advisable to have multi-faceted and multi-disciplinary members who share a common understanding of the project goals and objectives. Occasionally, a multi-jurisdictional team may be needed for projects whose scope extends to other regions or state(s).

5.2.2 Scope of these Guidelines

The intent of this guideline is to assist regional planners, traffic engineers and designers in developing TMPs for work zones. Many of the strategies developed and discussed facilitate planning, managing, operating, and evaluating work zone safety and mobility. The guideline defines a coherent framework for integrating TMPs and traffic operation policies into the project development process and encourages consideration of TMPs at an early stage in project development. Incorporating TMP early into the project delivery process has three advantages:

- Some TMP elements require lead times and should be identified early so funds can be allocated and work planned for each element,
- Identifying TMP components early in project delivery facilitates overall project budgeting and approval processes, and
- It ensures that impacts to highway users, businesses, workers and communities are minimized.

This guideline will help WisDOT develop and implement TMPs effectively and consistently statewide to enhance safety and mobility while minimizing delays caused by construction work zones.

5.3 Project Development Process

Implementation of a TMP minimizes work zone crashes and travel delay time, and allows for access needs promoting coordination within and around the work zone, improving quality, and allowing for completion of work on time. TMP must be part of the project life cycle. The concepts in these guidelines can be applied to projects that may potentially affect the economy, aesthetics, the environment, and social and cultural issues, including

transportation needs within the community near the proposed project.

Traffic management is not a snap shot of the project at a particular point in time during project development, but rather a continuous activity that is revisited, refined and updated to reflect changes in project scope. Attachment 5.1 illustrates the current Project Initiation Process (PIP). It is important to identify traffic management issues earlier in project development. Preferably the deliverables at the program level scope (Life Cycle 11) should include a preliminary TMP.

Conducting a TMP assessment during the PIP ensures that the TMP development/implementation costs are included in the project budget and encourages proper coordination and scheduling of projects along a corridor or in the region. The level of detail of the TMP assessment at this early stage depends upon the type of planning activity, the expected impacts of the project, and the availability of data.

5.4 TMP Development Process

The development of a TMP is an essential part of the overall project delivery and may affect the design, construction and material used in the facility itself. The TMP depends on the nature and scope of improvement, volume of traffic, staging alternatives and the capacity available on parallel or alternate highways. A well-thought-out and carefully developed TMP for the movement of traffic through a work zone will contribute significantly to the safe and efficient flow of traffic as well as the safety of other users and workers. See FDM 11-50-1 for further details.

Develop a preliminary TMP during the program level-scoping phase before the Project Management Plan (PMP) approval stage - see the PIP process for further details. Maintain consultation with the regional traffic engineer during TMP development.

5.5 Work Zone Impacts Assessment

One of the main objectives of developing a TMP is to identify work zone safety and mobility impacts and determine the appropriate approaches for mitigating and managing those impacts. Unresolved impacts can cause significant traffic delays, increase cost, create safety and mobility problems and affect project delivery. Impact assessment incorporates mitigation strategies into project delivery and reduces costs, saves time, and helps maintain traffic safety and mobility.

The degree of work zone impacts assessment depends on project complexity. Each project is different and will have different impacts. It is advisable to perform impacts assessment because the level of traffic safety and mobility is directly affected by the appropriateness of the TMP.

Work zone impacts are not limited to the actual project limits. Impacts can be far reaching and have adverse effects on businesses, communities, schools, other roadways, highway corridor, other highway projects, and even on other regions if the project is located at critical segments on the network.

Work zone impacts assessment may include

- Conducting qualitative and/or quantitative analysis of work zone impacts,
- Evaluating the effects of alternative strategies,
- Evaluating impacts of the selected work zone management strategies,
- Assessing construction approach/staging strategies,
- Assessing constructability issues.

By assessing work zone impacts early during project delivery, the scoping team can:

- Identify and understand the work zone safety and mobility impacts of the project,
- Understand the work zone safety and mobility implications of alternative project options and design strategies,
- Identify those projects that have greater work zone impacts and to allocate resources more effectively,
- Identify management strategies to mitigate work zone impacts of the project,
- Estimate costs and allocate appropriate resources for implementing TMP strategies,
- Understand, coordinate, and manage multiple projects and construction schedules to minimize overall impacts,
- Monitor and manage work zone impacts during construction, maintenance, and utility work, and amend or update TMP strategies if needed,
- Collect data for conducting work zone performance assessment,
- Help the Department use work zone performance assessment data to improve and update WisDOT work zone policies, procedures and practices.

In order for WisDOT to meet safety and mobility needs during highway maintenance and construction, and to meet the expectations of the traveling public and other stakeholders, it is important to systematically assess the work zone impacts of projects and take appropriate action to manage these impacts.

Depending on the scope of the TMP, factors that influence the level of impacts caused by a work zone include traffic conditions and characteristics, project characteristics, geographic/physical features, and aspects of the surrounding area (e.g., alternate routes, detours, businesses, schools, etc.). The assessment process may involve a high-level, qualitative review of these factors for some projects, and a detailed quantitative analysis using modeling and/or simulation tools for other projects. These guidelines and FDM 11-50-30 on freeway/expressway lane closure guidelines provide detailed procedures and tools to facilitate work zone assessment, evaluation and analysis. Consider the elements listed in Table 5.1 below as a guide for conducting work zone impacts assessment.

Table 5.1 Elements for consideration during preliminary work zone impact assessment

Project length (miles)	Duration of project (months or years)
Project location (urban, rural, suburban)	Traffic volume
Lane closure (policy and procedures)	Percent trucks
Percent reduction in capacity	Expected user delay
Availability of alternative routes & Detours	Accommodation for semi on alternative routes
Potential increase in crashes	Road user and worker safety
Impacts on other services (Transit, railroad, etc)	Emergency closures
Contingency plans	Environmental sensitivity (Community sensitive Design Issues - CSD)
Public/Media exposure	Conflicting projects (Region Coordination)
Multi-jurisdiction communication (buy-in)	State Patrol & local police involvement
Access for emergency providers, including fire, ambulance, police and hospitals	Businesses & residential access
Access for pedestrians, bicyclists & persons with disability	School access and school bus operation

5.5.1 Determine TMP Type

Selection of the appropriate TMP type represents one of the most significant decisions in planning and designing traffic control mitigation strategies. Factors that must be considered include project length, location, time when work will be performed, number of lanes, width of lanes, traffic speed, lane closures, primary or secondary oversize overweight route, and availability of adequate right of way. See the TMP type descriptions and Attachment 5.3 and Attachment 5.4 for details on determining TMP type.

TMP considerations must be made in the Concept Definition Report (CDR) and developed during program level scoping. Typically, once a TMP type has been identified, a small number of reasonable strategies will emerge for a particular project and, in many cases, only a few may be practical. After selecting the TMP type, strategies must be selected and appropriate elements for these strategies evaluated for cost effectiveness. This process ensures reasonable solutions are not thrown out. It is equally important to evaluate the cost effectiveness of proposed strategies and their elements before selecting what elements to include in the project estimate. Some TMP elements, such as temporary traffic signals, alternate route improvements, temporary widening, etc., require lead times and should be identified early so funds can be allocated.

5.5.2 Prepare Initial TMP

When preparing the initial TMP use the most current layout of the roadways, traffic data, traffic forecasts and projections. Every project will have a wide variation of traffic mix, travel patterns, roadway conditions, terrain characteristics, and population mix that makes an all-inclusive TMP impractical in the early stages of developing a project. The TMP at this early stage in project development is only approximate. The salient details of the complete TMP become apparent as more data becomes available. Update the TMP whenever the scope of the

project changes. Consult the FDM and the TGM for details on policies, procedures and guidance. The initial TMP should include the type of TMP selected with a brief narrative on project activities, anticipated work zone impacts, proposed construction staging, etc. See Attachment 5.5 and Attachment 5.6 for further guidance. Attachment 5.2, TMP Process Flowchart, shows the TMP development process.

5.5.3 Transportation Management Team (TMT) Selection

Large projects require extensive coordination, concurrences, detailed traffic impact analysis and teamwork from all participants. The regional scoping team may add other members from the stakeholders for projects requiring TMP type 4. Preferably, the team is composed of all regional WisDOT organizational units. When choosing representatives for the TMT, base the selection on the purpose, goals and constraints of the project. Balance the TMT with multi-facet, multi-discipline members with varied experience and expertise to ensure successful TMP development and project success. The variety of expertise presents an effective liaison group to meet the various needs of the TMP. The TMT may include representatives from:

- Regional Project Development (Design & construction),
- Regional Systems Planning and Operations,
- Real Estate,
- Technical Services,
- Regional Communications Director,
- Bureau of Traffic Operations,
- Division of State Patrol,
- Bureau of Project Development,
- Bureau of Technical Services,
- Bureau of Structures,
- Office of Public Affairs,
- Local Government (county and/or city),
- FHWA, and,
- Others deemed necessary.

5.5.4 TMP Stakeholders

If the Regional Project Scoping Team determines that TMP 3 or 4 is required, a separate TMT may be created. Refer to Work Zone policy statement in FDM 11-50-1 for member responsibilities.

5.6 Inclusion In DSR

Once a TMP is developed, it is documented on the TMP request for approval worksheet and referenced in the DSR. If the project does not require a DSR, e.g. a SHRM project, complete the “Request for TMP Approval” worksheet shown at the end of this procedure and submit with any attachment to the Bureau of Project Development (BPD) project services liaison. The TMP approval process detailed below provides additional guidance on the requirements for each TMP type. Example TMPs are available on the DOTNET (http://dotnet/dtid_bho/extranet/programs/workzone/workzone.shtm) and on the extranet at (https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/programs/workzone/workzone.shtm).

5.7 TMP Approval Process

Type 1

Projects in this category may cause minimal or no traffic delays as explained in detail in Attachment 5.3 (TMP Type Selection Matrix). The approval process for this type requires documentation in worksheet. It is advisable to reference appropriate Standard Details Drawings, pages in the “Work Zone Safety; Guidelines for construction, maintenance, & utility operations” handbook or a project specific traffic control plan. Highway maintenance activities not specifically referenced in this guide are discussed in detail in chapter 96 of the Highway Maintenance Manual. No further approval is required unless the project is subject to Federal Oversight. For Federal Oversight projects, the Bureau of Project Development (BPD), Project Services Section will forward the worksheet and the DSR to FHWA for review and approval.

Type 2

Projects in this category cause minimal traffic delays as explained in detail in Attachment 5.3 (TMP Type Selection Matrix) and may include: lane closures, delays exceeding criteria for short time periods, require detour, etc. Documentation is required in the worksheet with narrative on project description, AADT, TMP type, proposed staging and traffic control, public information, and other strategies and impacts listed in FDM 3-15-25

for the DSR. Highway expansion projects in this category should address project staging, traffic switches, and impacts to intersecting roadways. Attach the TMP worksheet to the DSR for approval. For Federal Oversight projects, BPD Project Services Section will submit the TMP to the divisional FHWA liaison for approval.

Type 3 and 4

These projects have high public interest because they have more significant impacts. They affect more road users for a longer period during construction than type 1 and some type 2 projects and must be documented in worksheet. Attach to the DSR a separate document describing traffic control, transportation operations, public information & outreach, and incident management strategies for type 4 projects. The worksheet may be used as an executive summary for type 4 projects. Attachment 5.5 and Attachment 5.6 show detailed layout for documenting TMP components. Regional traffic engineers, BPD regional liaison engineers, the Traffic engineering section in BTO and the appropriate FHWA liaisons will review and approve TMPs in these categories. Refer to the work zone policy statement FDM 11-50-1 for details on responsibilities.

Follow-up is required at the 90 percent stage to ensure conformance with the proposed strategies in the initial TMP.

5.7.1 Project Exception

The criteria used to determine the impact of a proposed work zone will be the 15 minutes delay between major city nodes on freeways and expressways (FDM 11-50-30). When the delay exceeds 15 minutes above normal recurring traffic delays between the major city nodes, a project exception may be requested. The degree of detail in the exception request will vary with project complexity and expected impacts. The exception request should include project description and a short discussion on the alternative mitigation strategies that were considered and those that are recommended to minimize delay while enhancing safety and mobility.

5.7.2 Design Phase

During the design phase, the project manager implements the recommendations in the TMP to the extent possible. The project manager may be required to collect additional data and/or perform additional analyses. It is the responsibility of the project manager to consult with the TMT or regional traffic engineer when there is a need for revisions to the TMP.

5.7.3 Update TMP

Review, refine, modify and update the strategies and elements identified earlier in PIP/PMP. It is recommended to review and update the TMP at the PS&E stage to ensure compliance with initial recommendations and subsequent updates to the TMP.

5.7.4 Implement TMP

A TMP implementation plan is necessary to ensure that responsibilities and procedures identified in the TCP, PIOP, TOP, and IMP are coordinated during project development and implementation phase. Before the TMP is implemented, it is advisable to identify key personnel and their responsibilities, and provide contact information. The project manager/leader and the contractor may discuss and agree (preferably at preconstruction meeting) on how emergency operations will be carried out. Further guidance is provided in FDM 11-50-20. If the project stipulates that a daily log of traffic control operation be kept, document this requirement in the implementation plan and share information with parties before beginning construction activities.

Identify line of authority for project manager and contractor personnel responsible for traffic control. Also identify personnel assigned the TMP monitoring responsibility.

5.7.5 Monitor TMP

Include monitoring and implementation requirements in the TMP. Include or refer to appropriate WisDOT policies, standards, and procedures for TMP monitoring and implementation. Changes to TMP type 3 and 4 by the region or the contractor may need to be reviewed and approved before implementation. TMP changes that should be documented are described further in FDM 11-50-5.13. Some elements of TMP strategies such as media releases, notifications to target groups, brochures, flyers, newsletters, etc., may need early distribution. Additionally, motorist notification, installation of fixed message signs, signing of detour routes, putting changeable message signs in place and work zone ITS require lead time.

During construction, the region should assign an individual(s) to collect data on the TMP. The data collected may be used to prepare a report on the successes and failures of the TMP. The data collected may include:

1. Verification of work zone setup,
2. Changes that were made during construction,

3. Changes that were made to the original TMP (include successes or failures),
4. Public/motorist reaction, identification of peak hours,
5. Average daily delays experienced, i.e., queues,
6. Frequency of complaints and the nature of the complaints,
7. Crash occurrence (type and frequency),
8. Surveys/feedback,
9. A track of implementation cost,
10. Person(s) responsible for the implementation of TMP.

5.7.6 Post Construction Project Evaluation

Following good planning principles, the strategies should be linked to measures of performance to determine how effective the applied strategy was in promoting safety and mobility at a work zone. Use the data collected while monitoring the TMP during construction to assess the quality, performance, and effectiveness of the TMP in achieving project objectives.

Performance measures are typically applied to fulfill four functions:

- To continuously improve services, i.e. to understand how the strategy is performing and whether modification of its application is necessary to improve performance;
- To strengthen accountability of either the Department's or the Contractor's personnel to ensure the strategy is achieving the desired effect;
- To communicate the results of strategies to the public, stakeholders, and upper management, and;
- To provide better information for effective decision-making, and resource allocation in the future.

Performance measures for work zones differ from one project to the next. For example, car-pooling usage would be used to measure the effectiveness of a TMP mitigation strategy such as ride share incentives. Additionally, a work zone may include new strategies, such as new technology (ITS) or innovative contracting strategies. In these instances, a unique performance measure may be developed to evaluate the effectiveness of the new strategy.

The post construction report should provide brief discussion on the following areas:

- Overall statement reflecting the usefulness of the TMP,
- The changes that were made to correct oversights in the TMP,
- What changes were made to the original TMP and how successful those change were,
- Public reaction to the TMP, (using surveys),
- Average delay time, queue, etc during construction,
- How frequent complaints were made about the project, the nature of the complaints and how they were resolved,
- Type of crashes/incidents that occurred during construction, and how they were resolved,
- Recommendations or suggestions for future projects, and
- Highlight the areas of the TMP that were successfully implemented.

5.7.7 Contingency Plans

The contingency plan lays out a course of action(s) necessary to restore or minimize traffic impacts when unexpected events (e.g., accidents, unforeseen traffic demand, inclement weather) occur in the work zone. The plan may include a decision tree, trigger points, personnel, or it may require standby equipment (See FDM 11-50-20 for further details.)

The contingency plan may include, but not be limited to the following:

- Information that clearly defines trigger points that require lane closure termination (i.e., inclement weather or when the length of traffic queue exceeds threshold),
- A decision tree which clearly defines lines of communication and authority,
- Specific duties of all participants during lane closure operations,
- Names, telephone numbers and cell numbers for the Regional Traffic Engineer or a designee, Project Manager/Leader, Contractor, and other personnel,
- Coordination strategy (and special agreements if applicable) between the Regional Traffic Engineer,

Contractor, Project Manager/Leader, DSP, Regional Maintenance Engineer, and local agencies,
- Contractor's contingency plan that addresses activities under the contractor's control within the work zone,
- Standby equipment.

5.7.8 TMP Implementation Costs

Estimate work zone management strategy implementation costs early in the PIP/PMP development process. Including these costs in the overall project budget is critical because obtaining additional funding later may be difficult. This action potentially avoids under-allocation of funds. Where feasible, the cost estimates for the various management strategies should be itemized and documented in the TMP.

5.7.9 Conclusions and Recommendations

Highlight key findings for the selected alternative and discuss feasibility, anticipated traffic or safety concerns (e.g., specific roadways with long estimated queues, accessibility issues, ability of the detour routes to handle diverted traffic) and any special provisions or issues.

5.7.10 Appendices

Appendices may be included in the TMP to highlight areas of interest to the project manager, the contractor or other stakeholders. The appendix may include: observed, historical, and/or estimated traffic volumes, speeds, travel times, level of service, delay, and accidents; maps; staging/phasing plans; lane closure charts; and detailed analysis methodology, assumptions, parameters used; etc.

5.8 Components of a TMP

A TMP minimizes project related traffic delays and crashes by effectively applying traditional traffic mitigation strategies. The strategies may include public and motorist information, demand management, incident management, alternative routes, construction strategies and other innovative/alternative contracting strategies. Additional guidance is provided in FDM 11-50-10 and examples are available on the Extranet at https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/programs/workzone/workzone.shtm.

5.8.1 TMP Application

A TMP is required on all projects. Projects expected to cause minimal or no traffic delays e.g., projects where work is done outside traffic lanes, work that involves mobile operations or work lasting a short duration, etc., may require a brief TMP which is usually the TCP. However, the TMP for projects that may cause delays, can range in size from one to hundreds of pages depending on complexity, location, length, duration and the extent of traffic impacts within and beyond the limits of the project. Examples of such projects include: single or multi-lane closures, pavement repairs, resurfacing or freeway/expressway reconstructions.

Consider major issues such as seasonal timing, duration of work and type of construction or rehabilitation operations when developing a TMP. A simple standardized TMP is not sufficient to address the needs of all projects since variability occurs from basic simple maintenance activities to very complex construction activities.

When developing a TMP, answer the following questions:

1. What type of traffic control is required for the work zone?
2. What is the likelihood of traffic delays?
3. What other circumstances must be accommodated?
4. What staging alternatives will allow for completion of work?

Develop solutions that are balanced, objective, practical, and flexible enough to be adopted for intricate project issues. A TMP is a dynamic document that is maintained and revised as the project development process progresses. The work zone part of the Plans, Specifications, and Estimate (PS&E) will contain much of the TMP components and elements. Other TMP elements may become part of the overall project management strategies or contained within the project design features and work operations. (see Attachment 5.7)

5.9 TMP Type Description

All highway construction or street maintenance, utility or construction activities performed by WisDOT, municipalities and local governments have been grouped into four major categories characterized by the degree of traffic impacts on mobility and safety. The categories are in a matrix based on the severity of impacts. At the lower end are type 1 projects that have little or no traffic impacts. At the high-impact end of this matrix are project types requiring detailed stand-alone TMP documentation. The matrix also provides some typical examples of projects within each TMP project type. Recommendations on elements to consider to facilitate the

selection of safety and mobility mitigation strategies are provided. Below are the descriptions that identify the 4 TMP project types and differentiates the impacts the projects may have on road users, local communities and businesses. Also included are the required TMP components (see FDM 11-50-5 for details on TMP components) and elements for each project type.

Type 1

Projects requiring this TMP type have little or no impacts to the traveling public. The duration of work may be short to moderate and occur during off-peak hours. Projects may also fall in this category because work occurs on a roadway with less than 1,500 AADT or the work is outside of the traffic lanes. Work zones may involve mobile operations or short duration lane closures for less than one hour.

Required TMP components

- Traffic Control Plan (TCP),
- Public Information & Outreach as appropriate.

Type 2

Projects in this category may include lane or road closures on conventional highways or freeways/expressways but cause minimal delays. Examples of projects requiring type 2 TMP include: resurfacing projects, pavement repairs, bridge deck overlays or painting that cause minimal delays or, bridge replacement on conventional highways, reconstruction with minimal delays, intersection improvements, etc.

Required TMP components

- Traffic Control Plan (TCP),
- Transportation Operations – As appropriate,
- Public Information & Outreach – As appropriate,
- Incident Management Plan for projects on freeways/expressways.

Type 3

Type 3 projects have high public interest because they affect more road users for a longer period during construction. Potential exists for traveler delay to exceed WisDOT criteria on more than 5 days during the work. Detours may be lengthy or require improvements to surface, geometry, or traffic controls. In urban areas, reconstruction may potentially disrupt business access and pedestrian/bicycle movement. Examples of projects that require this type of TMP include: resurfacing, reconstruction, pavement replacement or reconditioning, urban or intersection reconstruction projects with unusual access needs or high traffic delays, bridge replacement, or rehabilitation, etc.

Required TMP components

- Traffic Control Plan (TCP),
- Transportation Operations,
- Public Information & Outreach,
- Incident Management Plan for projects on freeways/expressways.

Type 4

These are long duration extensive (mega) projects with traffic and mobility impacts that may extend beyond metropolitan, regional, and state lines. Public interest is very high in these projects because traffic impacts affect a large number of road users, communities, interest groups, and businesses within the corridor and the transportation network. These are long lasting projects that require detailed staging. They typically involve multiple contracts and have significant impacts on regional and inter-regional traffic flow. Examples of projects requiring this type of TMP include: Marquette Interchange, USH 41 corridor, I-94 N/S corridor and I-39/29 Wausau corridor.

Required TMP components

- Traffic Control Plan (TCP),
- Transportation Operations Plan (TOP),
- Public Information & Outreach Plan (PIOP),
- Incident Management Plan (IMP).

The FDM provides guidance and tools to help project managers and traffic engineers through the process of evaluating the extent of traffic impacts of a given project. The matrix that follows is yet another tool developed to provide additional guidance in determining TMP types. Use available project information to select an appropriate

TMP type. If a project exhibits characteristics requiring a higher TMP, use the higher TMP type and refine mitigation strategies when additional information about the project becomes available. In addition, all interstate projects within the boundaries of a Transportation Management Area (TMA) that occupies a location for more than three days with either intermittent or continuous lane closures will require TMP type 3 or 4 mitigation strategies. The definition of TMA is provided elsewhere in this procedure.

5.10 TMP Type Selection Matrix

Traveling through a construction work zone can be difficult and often times confusing for roadway users. A well conceived, planned, and executed Traffic Control Plan could alleviate many of the difficulties and confusion. However, traffic control by its very nature, reduces roadway capacity and can potentially lead to delays and crashes. (see Attachment 5.4)

Impacts to Consider – The following are among the impacts that should be analyzed:

- User Delay - FDM 11-50-30 describes roadways and projects where it is critical to analyze user delay. It also includes methods for conducting the user delay analysis and mitigating the delay impacts.
- Safety – Identify potential unusual safety hazards in the work zone that may need additional protection, such as drop-offs, obstacles, or opposing high-speed traffic. Additional protection could include temporary barrier, temporary crash cushions, and close spacing of channelizing devices. Guidelines for use of temporary concrete barrier are found in FDM 11-50-35
- Access to nearby properties – Where access to business areas, schools, hospitals, or other large traffic generators will be disrupted during the project, determine all of the affected facilities and their access needs.
- Pedestrians, Bicyclists, Persons with Disabilities, Transit – Identify areas of pedestrian, bicyclist, and transit usage to be considered when developing the TMP.

Traffic impacts associated with reduced capacity must be evaluated early during project scoping. The WisDOT work zone policy statement (FDM 11-50-1) and the Statewide Freeway & Expressway Lane Closure & Delay Guidelines (FDM 11-50-30) provide additional guidance on minimizing traffic delays.

5.11 Accommodation of Pedestrian and Bicycle Traffic

Activities in work zones can and do disrupt mobility, safety, and access, especially in urban areas. Project managers, designers, project leaders and regional traffic engineers should ensure that accommodations are provided for pedestrians, people with disabilities and bicycles.

Lane restrictions, shifts, use of shoulders as travel lanes, detours, alternate routes and other traffic measures should all be designed to assist non-motorized road users whenever possible. Provide a safe convenient travel path for pedestrians or alternate route that replicates as nearly as possible the most desirable characteristics of the existing sidetracks or footpaths throughout all phases of construction. Avoid creating pedestrian paths that lead pedestrians into direct conflict with work vehicles, construction equipment mainline traffic or dead-ends. Ensure the alternative route or detour is maintained for safety, convenience, accessibility and is free from debris at all times.

5.11.1 Warrants

It is advisable to address the safe accommodation of pedestrians/bicyclists through the work zone early in project development. Situations that warrant special pedestrian/bicyclist considerations include the following:

1. Locations where the sidewalk traverses the work zone;
2. Where a designated school route traverses the work zone;
3. Where significant pedestrian/bicyclist activity or evidence of such activity exists; and
4. Where existing land use may generate such activity (e.g. shopping malls, businesses, concentrated housing developments, churches, senior center, transit stops, state/city/neighborhood playgrounds, parks or planned events).

5.11.2 Planning

Determine the traffic control impact on pedestrians, including significant generators such as schools, senior centers, transit stops and shopping areas.

1. Determine the level of accessibility needed for pedestrians in the work zone through observing existing pedestrian travel patterns, and make accommodations prior to the start of work.
2. Consider meeting with local community organizations (i.e., local blind organization, city ADA coordinator, and other special interest groups) through public meetings to address their concerns and

needs.

3. Develop outreach products that are made available in the appropriate formats for those with specials needs.

Assess the Work zone impact on existing pedestrian flow and then make sure that temporary facilities replicate as nearly as practical the accessibility features present in the existing pedestrian facility when the existing facilities are disrupted, closed, or relocated in the work zone. More extensive facilities, such as temporary asphalt paths, may need to be provided more frequently in urban locations or other areas of high pedestrian volume than in suburban or rural locations. Refer to MUTCD 6C.01 Temporary Traffic Control Plans, 6D Pedestrian and Worker Safety and 6F Temporary Traffic Control Zone Devices for accommodating pedestrians in temporary facilities.

5.11.3 Design

Provide pedestrian information such as advance warning information, transition information, work zone information, and ingress and egress directions for pedestrians throughout the work zone.

The work zone pedestrian accommodation should utilize a temporary route that at the minimum:

1. Defines detoured routes clearly. Where walkway or bicycle paths cannot be safely provided, direct users to a safer detour;
2. Provides advance signage at intersections rather than mid-block locations.
3. Physically separate pedestrians and vehicles with appropriate traffic control devices, temporary plastic fencing, etc. where practical;
4. Avoids mid-block crossings, except where no suitable alternative exists due to utility conflicts or other construction staging;
5. Provide temporary lighting for all walkways that are currently lit;
6. Stage construction operations so that only one walkway or bicycle path is closed at any time, with crossings provided at least every other block and more frequently in downtown areas with high volumes of pedestrian traffic;
7. Plan construction so that walkways and bicycle paths are closed for a very short time;
8. Provide adequate locations and continuous access for temporary transit stops;
9. Abides by “The Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG),” July 1998 Edition (The U.S. Access Board) and the “Public Rights of Way Accessibility Guidelines (PROWAG)”;
10. Provides clear and positive guidance to delineate a path with appropriate traffic control devices, temporary plastic fencing, etc. ;
11. Maintains a continuous, firm, and stable accessible path of travel either around or through the work zone throughout all construction phases.

Ensure compliance with Americans with Disabilities Act (ADA) of 1990 requirements by:

1. Providing an alternate route when existing pedestrian facilities are disrupted, closed, or relocated in the work zone. Temporary facilities should replicate the features present in the existing pedestrian facility.
2. Ensure a minimum sidewalk width of 36" (a 48" width is desirable), erect curb ramps, and provide passing space (minimum 5 foot by 5 foot space every 200 feet).
3. Maintain a minimum width and smooth surface to avoid creating tripping danger and to minimize barriers to wheelchair use. This includes providing ADA compliant facilities.
4. Make all barriers and channelizing devices detectable for pedestrians with visual disabilities. Note that the use of caution tape stretched between traffic control devices is not adequate and not acceptable.
5. Consider using additional devices for visual disabilities, such as audible information devices or accessible pedestrian signal.

During design maintain pedestrian access to businesses, residences, transit stops, etc. and provide temporary nighttime lighting for pedestrian walkways throughout the work zone if there is a need, especially if the project is within the vicinity of senior centers, hospitals, or institutions of higher learning.

5.12 TMP Potential Elements Check List

The example provided in Attachment 5.5 is a typical layout of TMP components and elements for a type 4 project. The list of elements is only partial. Reorganize, delete, or expand this list to include strategies that apply to the needs of your project. TMP type 1, 2 & 3 will have some similar elements but since these projects have less traffic impacts, the documentation is less extensive and can be included in the TMP worksheet, the traffic control plan and special provisions. Attachment 5.5 is more descriptive and should be used as a guide for documenting mitigation strategies for Type 4 TMPs.

5.13 Documentation of Changes to TMP

TMP documentation has an added advantage of enhancing communication amongst stakeholders by enabling sharing of information from project scoping through construction. It is therefore essential that TMP revisions be documented if there is significant change to the impacts on the traveling public or if the TMP revisions cause a contract change order. For instance, changes to lane closures should be documented if they will increase traveler delay above the 15-minute threshold on freeways and expressways. Changes to the TMP may also be generated through a proposed Cost Reduction Incentive (CRI).

Examples that may require revisions to the TMP documentation include:

- Extended duration of temporary full roadway closures into weekday or weekend peak traffic hours (example - taking an unanticipated weekend full freeway closure to erect bridge girders or to trench a culvert across the freeway)
- Additional road closure, or additional ramp closure that adds more than 15-minutes above typical travel time
- Additional closures that affect OSOW freight movement
- Changes in scope or intent of work, including work limits, work hours and time of year
- Construction stage changes that affect roadway geometry, lateral clearance, design speed, vertical clearance, lane width and roadway closures
- Extra Law enforcement contracts that were not originally anticipated
- Both positive and negative lessons learned that impact safety, traffic flow and project delivery time
- Revised detour routes that are an increase in distance and travel time for motorists compared to the original approved detour

Project engineers are encouraged to engage and confirm with the region traffic engineer and their region's BTO contact to determine whether the above listed traffic impact changes warrant an official documented change to the TMP.

Examples of changes that may not need revised TMP documentation may include:

- Planned long-term closures that are extended for short durations compared to their original planned closure schedule(less than 25%33% increase of closure duration;
- Lane closure time period that does not cause additional travel delay;
- Unanticipated, but STOC approved, temporary overnight full roadway closures.

Document the addendum to the TMP and share via:

1. E-mail to Regional PDS and Traffic (who signed the original TMP) and Statewide Bureaus (BPD/BTO), and FHWA if Federal Oversight project, describing the changes. The original TMP documentation/approval worksheet should be attached to the e-mail.
2. Revised TMP documentation/approval worksheet noting the changes. This also could be transmitted by e-mail.

References

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25. Federal Highway Administration, Accommodating Pedestrians in Work Zones. Available at http://safety.fhwa.dot.gov/wz/planning/fhwasa03011/fhwasa03011.pdf .

LIST OF ATTACHMENTS

Attachment 5.1	Project Initiation Process & Project Management Plan
Attachment 5.2	TMP Process Flowchart
Attachment 5.3	TMP Type Selection Matrix
Attachment 5.4	Example TMP Type Mitigation Strategies and Elements
Attachment 5.5	TMP Potential Elements Check List
Attachment 5.6	TMP Documentation Example Layout
Attachment 5.7	TMP Documentation and Request for Approval

FDM 11-50-10 Components of a Transportation Management Plan *December 22, 2011*

10.1 Components of a Transportation Management Plan

A Transportation Management Plan (TMP) may include public and motorist information, demand management/transportation operation, incident management, alternative routes, construction strategies and other innovative/alternative contracting strategies. Type 1 projects may have one or two of the TMP components

while a type 4 project will require all components to be discussed and included in the TMP.

Refer to FDM 11-50-15 for further discussion on work zone traffic control plan process.

10.2 Public Information & Outreach Plan (PIOP)

WisDOT has a major role in ensuring the public is informed about traffic impacts related to construction activities. Accurate and timely reporting of project information to the public is a valuable element of the overall TMP strategy. A public information and outreach plan (PIOP) lays out clear and concise strategies and procedures to reach out to the traveling public and other stakeholders with information about existing traffic operations and planned changes due to proposed project activities. The PIOP must be updated throughout the project life cycle to address issues as they arise.

Regional offices perform public information and outreach activities and implement the overall PIOP in coordination with the Office of Public Affairs (OPA). PIOP is used to ensure that:

- Stakeholders are informed about the project and its impacts,
- OPA is aware of all PIOP issues,
- Communities, businesses, and schools directly impacted by the project are informed about the project's impacts through participation,
- Road users are informed in a timely manner of possible negative impacts and where possible information on alternate routes is given,
- Emergency response agencies (e.g. law enforcement, ambulance service providers, hospitals, city and county officials) are informed of changes that might affect their operations.

10.2.1 PIOP Requirements

Each project presents varying degrees of challenges. Freeways/Expressways, and high-volume urban locations with commercial access requirements and pedestrian/bicycle traffic present the most challenges and require the most extensive PIOP. Minor rural projects on low volume roads will not require as much detail. A PIOP may consist of any of the following basic items: (see Attachment 10.1)

- Media news release,
- Public meetings or speaker forums,
- Stakeholder and emergency response agencies meetings
- Notices to the traveling public (Radio, TV, print media),
- Brochures and Mailers, videos, slides, presentations, etc
- Paid advertising,
- Special notification to targeted groups,
- Telephone hotline,
- Public information center,
- Traveler information:
- Portable Changeable message signs,
- Dynamic message signs,
- Ground mounted signs,
- Planned lane closure signs,
- Portable work zone traveler information systems (ITS)
- Other affected group information,
- Other methods including the Internet.

10.3 Transportation Operations Plan (TOP)

Transportation Operations Plan (TOP) is a set of strategies adopted for the sustained operations and management of the work zone impact area. TOP includes the identification of strategies that are used to mitigate impacts of the work zone on the highway corridor /network. See Attachment 10.2 for a list of example strategies.

The scope of the TOP components is determined by the characteristics of the project and should be considered in concert with other safety and mobility strategies. Develop TOP if lane or road closures on freeways, expressways, other Corridors 2020 routes, or urban arterials may cause delays that exceed the criteria of FDM 11-50-25, cause access restrictions or unusual safety concerns. Mitigation strategies are further described in FDM 11-50-30 and FDM 11-50-40.

10.4 Incident Management Plan (IMP)

Incident management plan is a set of strategies used to manage work zone traffic operations. These strategies include monitoring traffic conditions within the work zone and adjusting traffic operations based on changing conditions. IMPs address unplanned events or incidents for TMP project type 2 and on freeways/expressways, and all TMP type 4 projects to ensure effective management of responses within the work zone. Formal IMP documents are not required for TMP type 2 and 3 projects on conventional highways, but if the project has detours or other temporary access restrictions, coordinate with emergency service providers regarding incident and access planning. Modify and update the IMP to address issues as they occur. An IMP helps the contractor and the Department to respond appropriately to incidents during construction within a reasonable timeframe in order to maintain traffic flow through the work zone safely. The IMP is part of the TMP and shall be submitted along with the TMP at the time of the completion of the draft PS&E. The draft IMP should be submitted along with the TMP worksheet at the time of the Design Study Report (DSR). Instructions for completing an IMP and a sample outline can be found in TGM 6-3-10.

LIST OF ATTACHMENTS

Attachment 10.1	Public Information & Outreach Plan Checklist
Attachment 10.2	Transportation Operations Plan Checklist

FDM 11-50-15 Work Zone Traffic Control Plan Process *December 22, 2011*

This procedure explains the process used to develop a work zone traffic control (WZTC) plan. The overall process is shown in Attachment 15.1. The text below explains some of the more significant actions in this process.

15.1 Project Scope

This refers to the Project Scoping Process described in FDM 3-5-3. Traffic engineers from the region Planning & Operations Section need to be included in this initial scoping process.

15.2 Traffic Control (T.C.) Scope

The Project Manager will collect all input received during scoping and begin developing the traffic control scope. Refer to the Design Plan Review Checklist for Work Zone Traffic Control in FDM 11-50 Attachment 20.3.

15.3 Construction Under Traffic

Early in the process the feasibility of constructing the project under traffic must be addressed. The designer must consider issues such as length of construction with a detour and without, and the preferences of local officials and the public.

15.4 Detour Required?

The region Project Development Section and the Planning and Operations Section (traffic staff) will determine if the project will have a detour and where it will be. This will be done with input from local officials and other department staff as appropriate. Designers must also determine who will sign the detour (a contractor or state forces) and what improvements (if any) the detour route needs to accommodate the increased traffic.

15.5 Develop Staging Plan

Based on scoping decisions, designers develop a staging plan on how traffic will be handled (staged) throughout the life of the project. The staging of the construction work and the traffic handling are often dependent on each other. Therefore, planning for construction operations and planning for traffic handling need to be considered together.

15.6 SDDs Adequate

If the traffic control can be handled entirely by Standard Detail Drawings, then designers will submit a list of those drawings to the region operations (traffic) staff for review and concurrence. This list shall then be considered to be the final traffic control plan. For many projects a useful addition to the plan is a project overview sheet with a line drawing showing locations to use details of the SDD's. Such a drawing is useful to illustrate how the SDD's relate to each other and to ensure that no necessary traffic control details are overlooked. It also helps the contractor and project manager to determine exactly what will be needed on the project. If the SDD's do not adequately deal with the traffic control requirements, then a preliminary traffic control plan & details will be prepared.

15.7 Prepare Preliminary T.C. Plan & Details

The preliminary plan should detail the exact traffic patterns, types of devices to be used, taper lengths, spacings, etc. However, since these are preliminary sheets, it is not necessary to show each individual traffic control device. Designers must also identify which SDDs will be needed in the plan. Special provisions are usually not necessary at this point.

15.8 Preliminary Plan & Details Review

The designer meets with region personnel (and central office staff and others if necessary) to review the preliminary drawings before proceeding on the final Traffic Control Plan. This review will aide the traffic control plan designer.

15.9 Finished Traffic Control Plan & Review Meeting

It is recommended that this step become a new milestone in the project development process. The meeting can be an actual face to face meeting, a teleconference or some combination. The designer's WZTC checklist (see FDM 11-50-20) should be completed by this time and brought to the plan review meeting. The plan and special provisions at this stage shall be complete with all the detail and information necessary for PS&E except that quantities are not necessary at this time. Designers should document the results of this meeting, including meeting participants, place a copy in the region files, and send a copy to the Bureau of Project Development (BPD) project development engineer for Central Office Files. The date of this meeting shall also be documented in the PS&E plan letter.

15.10 Contractor Involvement

In rare instances the Wisconsin Transportation Builders Association (WTBA) may be used as a resource on traffic control issues. Contractor involvement in the WZTC process shall be limited to such topics as, general constructability, production rates, and timing constraints. Contractor involvement should be coordinated with the WTBA.

15.11 Bureau of Traffic Operations Involvement

The decision to involve the Bureau of Traffic Operations (BTO) on a project shall be determined by the region Planning & Operations Section. The region Planning & Operations Section will act as the liaison.

Projects that may require BTO input into a traffic control plan include, but are not limited to, plans that contain traffic control staging, complex urban or rural projects, projects that involve at-grade railroad crossings, politically sensitive projects, and highly unique situations that require a statewide perspective. BTO shall be involved in the review and approval of temporary speed zone declarations when reducing the speed limit from 65 mph.

LIST OF ATTACHMENTS

Attachment 15.1 Work Zone Traffic Control Plan Process

FDM 11-50-20 Safety in Work Zones *June 14, 2012*

20.1 General Requirements

This procedure is intended to assure the maximum safety of motorists, pedestrians, and construction workers on all WisDOT construction projects.

The guidance for the design of Work Zone Traffic Control is found in Part 6 of the MUTCD. Part 6 contains national requirements for all roads, with the consideration that a state trunk highway has characteristics and traffic volumes greater than the minimum type of roadway which Part 6 addresses. For this reason statewide policy has been developed concerning long term work zone traffic control on the state trunk highway system. When WisDOT administers projects on the local system, the devices used must meet WisDOT specifications and the minimum requirements of Part 6; however, the layout for the work zone traffic control itself should meet the maintaining authority's policy which may differ from WisDOT policy.

20.2 Use of Standard Detail Drawings

Standard Detail Drawings have been developed which can be used for typical situations. The designer must be sure the situation is as shown in the detail and that there are no unusual characteristics of the project which make the detail not appropriate. If the project has unusual characteristics, the information on the detail should be used as a typical method for controlling traffic and the appropriate modifications made in the development of a project specific detail. Designers should note the standard detail drawings show only the traffic control items needed, they do not reflect the geometric layouts of the crossovers or temporary roadways. Each crossover or

temporary roadway needs to have the geometric layout information and quantities required for the construction of the temporary roadway listed elsewhere in the plan.

20.3 Traffic on Divided Roadways

When planning construction projects on divided highways, all feasible alternatives that would maintain one-way operation on each roadway should be considered. These include the following options.

- Construction under traffic
- Placing traffic on existing or renovated shoulders.
- Constructing temporary bypasses.
- Detouring traffic to other routes.

If one of these alternatives is determined to be feasible, its cost should be compared to the alternative of providing a means of separating two-way traffic on one roadway of the divided roadway. Maintaining one-way traffic on each roadway is the preferred method of control unless the construction operations do not allow it.

Two-lane, Two-way operation (TLTWO) on one roadway of a normally divided highway shall be used only after careful consideration of other available methods of traffic control. Where the TLTWO is used, the traffic control plan shall include provisions for the separation of opposing traffic.

When the TLTWO is used on one roadway of a normally divided highway, it is not sufficient to separate traffic with only centerline striping, raised pavement markers and complimentary signing. Typically, the separation of opposing traffic in this situation includes the use of either tubular markers, drums or concrete barriers in addition to other items mentioned above.

In the transitions at the ends of the TLTWO, the typical traffic control plan will include a variety of the commonly available types of traffic control devices depending on the situation. Concrete barriers should be considered for use in high speed and relatively high traffic volume situations.

20.4 Crossover Design

20.4.1 Pavement Structure

Once a cross-over is in use, pavement failures cannot be tolerated because traffic must be stopped to make repairs. Past experience has shown a five inch (125 mm) minimum asphalt pavement over a 12 inch (305 mm) minimum CABC has been a successful pavement structure throughout various areas of the state. Unique traffic situations are expected, such as heavy truck traffic or the crossover is going to handle only automobile traffic for a short duration, an individual pavement design for the crossover may be warranted.

20.4.2 Retention of Temporary Crossovers

There are times when it is useful to leave a temporary median crossover in place after the construction is complete. Although it is not WisDOT policy to leave all median crossovers in place, there is merit in looking at crossovers on a case by case basis to determine if removal is appropriate. Concerns about leaving a crossover in place include:

- Drainage
- Snow melt running onto the travel lanes
- Illegal U-turn usage
- Future maintenance
- Life of the surface without traffic on it
- Appropriate location for future use

The situations when it would be advantageous to leave a crossover in place include:

- In the area of a long bridge, if the long bridge is damaged the crossover could be used for emergency rerouting of traffic.
- Locations where emergency parking is needed off the travel lanes
- Use for future work if a project is programmed in the foreseeable future (2-4 years) and the crossover is in an appropriate location.

When leaving a crossover in place the following design parameters must be considered:

- Safety
- Alignment, desirable degree of curve, width
- Cross slope for drainage to median
- Median drainage, pipe size, design frequency

- Pavement thickness and type to support traffic and resist weathering during non-use
- Delineation when not in use (See SDD Traffic Control, single lane crossover for an example) and provide appropriate signing to disallow U-turns.

20.4.3 Placement of Crossover

When locating the crossover, be sure the superelevation can fit in with the existing pavement. Locate it far enough away from intersections and interchanges to allow traffic to normalize prior to potential conflicting traffic from an intersection or ramp. Typically a lane closure is prior to a crossover so enough space must be provided to allow the lane closure to occur outside the interchange or intersection area. Physical constraints such as bridges, marshy median areas, bridge piers, etc. also influence the locations of the crossover. The location of the crossover should be such that the height of both roadways is approximately the same.

20.4.4 Geometric Design

Part 6 of the MUTCD states "the basic safety principles governing the design of permanent roadway and roadsides should also govern the design of temporary traffic control zones. The goal should be to route traffic through such areas using geometrics and traffic control devices comparable to those for normal highway situations). In designing the layout for the crossover, when the non-construction posted speed or travel speed is 65 mph on the roadway, the degree of curve is suggested to be 1 deg 30 min or less.

20.5 Speed Limits During Construction

Some motorists respond to a reduced speed, while others do not see a need to slow down. This may cause a differential in speed among drivers which is at times more dangerous than consistent higher speeds. Studies have indicated motorists will drive the speed they feel comfortable driving. Unless there appears to be a physical limitation to their speed they will typically not reduce their speed unless there is an enforcement presence. Part of the difficulty in enforcing lower speeds is the difficulty of stopping a vehicle in the work zone. This means enforcement must be stationed on either end of the work zone to ticket vehicles.

In 1994, Wisconsin legislature passed a law doubling the fines in work zones for certain moving violations. Speeding in a work zone is one of the violations for which the fine is doubled. For this law to be effective, reduced speed limits must be warranted, consistently set, and clearly posted in the work zone. On projects which have tourist traffic, congested conditions, major traffic volumes or other factors which make speed or other moving violations a major concern, the sign "Fines Double in Work Zones" (W21-61 or W21-62) may be placed on either end of the project.

Accepted practice has been to reduce the speed limit on some roads while the road is under construction, especially at times of work activity. The speed reduction is typically limited to 10 mph below the regular posted speed limit on the rural 65 mph freeway. It is normally not recommended to reduce the speed on a rural freeway which is normally posted at 55 mph. On some freeways in urban areas a reduction from 55 mph to 45 mph may be warranted if geometrics during construction are modified from the preconstruction situation. Cases where the speed is usually reduced include where traffic is shifted over to run two-way on a two lane roadway. The rural speed limit (typically 65 mph) should be reduced because of the crossover geometrics and, at times, narrowed lanes and shoulders. The length of the reduced speed zone should be as short as feasible. The public seems to understand this sort of speed reduction.

A reduction in regulatory speed limit on a rural 2 lane highway normally posted at 55 mph is not needed in most cases. If the method of construction and staging of traffic requires a reduced speed, it should most frequently be handled by posting an advisory speed at the geometric problems.

If it is decided a reduced regulatory speed is warranted, the reduction can be a maximum of 10mph. Factors to consider when exploring a reduced regulatory speed include proximity of the work to the traffic lanes, separation method of vehicles from the work area, and type of work being performed.

Where only one lane is closed and workers are not present, conformance to a reduced speed is poor.

More detailed guidance and criteria for reduced work zone speed limits are provided in TGM 13-5-6.

Safety of motorists through a work zone can be handled by a combination of advisory speeds and the actual speed limits. Workers need to be protected, but staging to remove traffic from areas near the workers, or providing positive separation such as barrier is a better way to enhance worker safety than is a reduced speed zone.

The reduction in speed should be considered on a case by case basis and must have region traffic approval and a declaration prepared to make the speed enforceable. If reducing speed from 65mph, a temporary speed zone declaration shall be completed and approved by the Bureau of Traffic Operations.

Projects with anticipated capacity or other traffic handling problems typically have extra enforcement.

In some cases, some of the design elements of the temporary traffic control are designed at less than the posted speed. In these cases, if the feature is isolated or at a spot location, this can be handled by posting an advisory warning sign with a subsign with the appropriate speed.

20.6 Lights on Drums

Attachment 20.1 presents WisDOT's policy for the use of Type "C" Steady-Burn Lights on traffic control drums.

20.7 Design of Traffic Control Plans

A checklist for use in the design of traffic control plans is included in Attachment 20.2.

20.7.1 Signing

On STH projects all warning signs which represent a changed condition are to be orange and black except the No Passing Zone Pennant (W14-3), Object Marker (W5-52) and RR X-ing Ahead (W10-1). This is generally noted by changing the code to WO instead of W and including the general note "WO signs are the same as W signs except the background is orange". If there are existing yellow and black warning signs in place, they do not need to be changed to orange as long as the condition being warned of still exists. Any signs which are no longer applicable due to the traffic control should be covered or removed. All diamond shaped signs are 48" x 48" unless space constraints such as a narrow median or terrace do not allow this size sign to be used.

20.7.2 Modification of Type I and Type II Signs

At times an existing message on a freeway guide signs or other permanent signs need to be altered or the sign covered if it is no longer appropriate. Conflicting permanent signs to be covered should be indicated on the traffic control sheets, and must clearly show the sign or the part of the sign to be covered. Signs required to be covered should be listed in the quantities with the appropriate sign covering details. Under some circumstances, there may be multiple cycles of covering and uncovering throughout the course of construction staging. The sign covering will be measured separately for each cover/uncover cycle. In addition, the number of cycles should be listed in the quantities and, if necessary, should indicate the stage in which the sign will be covered and uncovered.

Designers should begin including the new items immediately into the May 2012 PS&E submittals. Do not use the existing STSP for type I sign covering. Do not write special provisions that make covering Type II signs incidental.

Conflicting permanent signs to be covered should be indicated on the traffic control sheets, and must clearly show the sign or the part of the sign to be covered. Signs required to be covered should be listed in the miscellaneous quantities with the appropriate sign covering details.

Under some circumstances, there may be multiple cycles of covering and uncovering throughout the course of construction staging. The sign covering will be measured separately for each cover/uncover cycle. In addition, the number of cycles should be listed in the miscellaneous quantities and, if necessary, should indicate the stage in which the sign will be covered and uncovered. Table 20.1 is an example table format that can be used for covering signs for traffic control in the miscellaneous quantities sheets.

Table 20.1 Covering Signs for Traffic Control Example Table

Stage	643.0910 Traffic Control Covering Signs Type I			643.0920 Traffic Control Covering Signs Type II		
	Each	Number of Cycles	Number of Signs	Each	Number of Cycles	Number of Signs
Stage 1	*a* * *b*	*a*	*b*	*x* * *y*	*x*	*y*
Stage 2	*a* * *b*	*a*	*b*	*x* * *y*	*x*	*y*
Stage 3	*a* * *b*	*a*	*b*	*x* * *y*	*x*	*y*
Stage 4	*a* * *b*	*a*	*b*	*x* * *y*	*x*	*y*
TOTAL						

When a new sign with a special message is needed, a detail for that sign needs to be developed and included in the plan. Examples of these types of messages include:

- HWY XX BRIDGE
- UNDER CONSTRUCTION
- EXPECT DELAYS
- USE ALTERNATE ROUTE
- 40 TON WEIGHT LIMIT
- 10 FEET MAX WIDTH
- 6 MILES AHEAD
- HWY XX CONSTRUCTION
- BEGINNING "DATE"
- USE ALTERNATE ROUTES

On some projects it may be advisable to sign an alternate route or construction bypass.

20.7.3 Pavement Marking

The use of temporary raised markers to supplement the temporary line is very helpful, especially in areas where the alignment is changed from the existing condition and crosses different colors of pavements. Temporary raised markers provide unique wet night reflectivity throughout the project life, however they are not resistant to snowplows so the season of the project must be carefully considered to be sure the markers will stay in place, or there are provisions in the contract to replace the markers after a snowplow removes them. The feasibility of using temporary raised markers depends on the need for additional guidance based on the geometric difficulty of navigating the work zone during different stages.

The plan should provide for the removal of existing markings. On relatively new asphaltic surfaces, removable non-reflective black mask-out tape may be used to cover the existing markings.

20.7.4 Flexible Tubular Markers

The use of orange flexible tubular markers is reserved to separate two-way traffic so drivers know there is oncoming traffic on the other side. These are typically spaced 50 feet apart on high speed facilities. The spacing is reduced on lower speed and urban facilities.

Flexible tubular markers in other colors may be used as delineation on the outside of traffic lanes if there is not adequate space for other more prominent devices.

LIST OF ATTACHMENTS

Attachment 20.1	Policy for the Use of Type "C" Steady-Burn Lights on Traffic Control Drums
Attachment 20.2	Work Zone Traffic Control Plan Review Checklist

FDM 11-50-30 Statewide Freeway & Expressway Lane Closure & Delay Guidelines *December 22, 2011*

30.1 Introduction

Maintaining safe flow of traffic through a work zone during construction should be carefully planned and executed to improve work zone safety and minimize inconvenience to the motoring public. Providing detours is sometimes a preferred alternative, but, for many reasons it is frequently impractical for freeway and expressway traffic, and traffic flow is maintained through the work zone. Traffic lanes may be closed, shifted, or encroached upon in order to provide room for construction or maintenance activities. When this happens, the remaining lanes available shall be evaluated for expected work zone capacity and how they will perform under the demand volume on the roadway during the closure. A transportation management plan (TMP) must be developed to promote safety and minimize the impacts on traffic operations according to the final rule on Work Zone Safety and Mobility established by FHWA in September 2004 [1].

These guidelines make reference to the current WisDOT work zone policy, “Guidelines for Developing Work Zone Traffic Management Plans.” [2]

This document includes guidelines for planning typical lane closures and methodologies for considering regularly occurring high volume periods with special considerations for holidays and planned special events. These guidelines also include suggested procedures and methodologies to estimate the capacity of a roadway segment, determine traffic demand, and estimating queues and delays using traffic volume data. Once these factors are determined, necessary mitigation strategies can be developed in order to alleviate or eliminate user delay during a lane closure. Guidelines for emergency maintenance and construction operations and night freeway work operations are discussed and strategies are referenced for further investigation. Attachment 30.1 is a flowchart of the Lane Closure Analysis Process and shows the typical course of action that should be taken in evaluating lane closures. This following process will be described in detail throughout the document.

1. Determine route-specific maximum delay guideline and recommended lane closure times.

2. Estimate capacity under proposed lane closure (using Table 30.3 and other factors).
3. Estimate hourly demand profile (traffic volumes)
4. Estimate queues and delays using appropriate tools.
5. Identify appropriate mitigation strategies.
6. Plan and prepare for special conditions.

30.2 Lane Closure System (LCS)

The Lane Closure System (LCS) is a web-based system for the request and approval of lane closures on all state highways. The LCS is a tool the Department uses to track lane closures, coordinate adjacent closures and special events, and share traveler information with the public. All closures and restrictions on freeways and expressways require approval by the Regional Traffic Engineer (RTE) and Regional Traffic Supervisor.

30.3 Special Events and Holiday Work Restrictions

Special events that generate traffic in addition to normal traffic volumes should be considered in developing the transportation management and lane closure plans. A special event is defined as an event that generates a certain minimum attendance threshold according to the location of the event shown in Table 30.1.

Table 30.1 Special Event Attendance Criteria vs. Location

Location of Special Event	Population of Influence Area	Minimum Attendance (per day)
Major Metropolitan Area	Over 500,000	30,000
Urbanized Area I	50,000 – 500,000	15,000
Urbanized Area II	20,000 – 50,000	10,000
Rural Area	Under 20,000	5,000

The contractor shall not close a lane(s) in the direction on approaches to the event in the 2 hours before an event and in the outbound direction for 2 hours after an event ends unless the lane closure is part of an acceptable long-term traffic control staging for the project. An illustrative list of specific events that may apply is provided for the Regions in Table 30.2.

Table 30.2 Statewide Special Events that may prohibit lane closures

All Regions	Region Specific
Major holidays	Summer Fest
Major recreational destinations	Brewer games
Major shopping malls	EAA fly-in
Farm progress days	Packer football home games
Major auctions	Badger football home games
Concerts	
Tournaments	
Gun deer season	
County fairs	

- Freeway and expressway lane closures are not allowed on the following holidays, other than accepted long-term traffic control staged projects:
  - Easter

- Memorial Day
- Fourth of July
- Labor Day
- Thanksgiving
- Christmas
- New Years Day

- Freeway lane closures are not permitted after noon on the day preceding a holiday. For holiday weekends, freeway lane closures are not permitted after noon on the day preceding the holiday weekend until 6:00 AM (or after the peak hour traffic volumes occur) the day after the holiday weekend.
- Permitted freeway lane closure times may vary when high attendance is expected for special events. The actual permitted periods of lane closures at locations influenced by increased traffic due to special events will depend on the assessment of roadway capacity available compared to expected demand volumes including additional traffic generated by the special event.
- Freeway shoulder closures shall follow the same restriction times as lane closures during special events.

30.4 Peak Hour Restrictions

Peak hours are defined as the hours of the day that observe the largest utilization of capacity, which may cause user delay. Peak hour times vary depending on the location of the roadway and the types of users traveling on the roadway. In developed, urbanized locations, there is typically a morning and evening peak period during the weekdays. Consult the Regional Traffic Engineer or the LCS planning tool for peak hour restrictions for the particular roadway segment being analyzed. No lane closures shall be permitted for short-term or short duration maintenance, utility, surveying or law enforcement reconstruction operations during normal peak periods unless peak hour volumes are below 1,600 passenger cars per hour per lane (pcphpl) unless accepted by the Regional Traffic Engineer.

30.5 Estimate Capacity Under Proposed Lane Closure

It is critical to estimate the capacity and traffic volume in each direction for hours of the day that proposed work operations will cause lane closures. Delays are expected in rural lane-restricted areas when the entering traffic volume exceeds 1,600 pcphpl. This is roughly equivalent to 1,280 vehicles per hour per lane with 20 percent heavy trucks. Highly urbanized areas with lane restrictions may be able to accommodate higher traffic volumes, possibly up to 1,800-2,000 pcphpl. Varying local conditions and site specific conditions need to be considered when determining an appropriate capacity figure to be used and the Regional Traffic Engineer should be consulted.

TRADAS planning data and freeway operations ATMS data can be used to determine traffic volumes being carried through a highway segment on a given day of week during a certain month. The user can then analyze the segment by reviewing the times when the roadway segment demand is under or over capacity during normal operating conditions. Reference lines for capacities of 1,500 vphpl and 1,800 vphpl are provided on the output table as a point of reference for the user; however, the approximate capacity of the chosen segment should be calculated and compared to the volumes provided by the lane closure planning tool output table. Once the capacity thresholds are established for the anticipated conditions, the recommended hours for the lane closure can be determined. This information is provided in an output table and suggested lane closure times are provided in a textbox.

Factors that will reduce traffic capacity in work zones:

1. Restricting lanes in one direction from 3 to 2, or from 2 to 1, will reduce capacity by as much as 800 pcphpl (from 2,400 pcphpl down to 1,600 pcphpl) in rural areas and by 400-600 pcphpl (from 2400 pcphpl down to 1,800-2,000 pcphpl) in highly urbanized, aggressive driving areas.
2. Poor geometrics in median crossover alignment, forming a lane restriction, shifting traffic to an existing shoulder, or uneven terrain will reduce capacity by as much as 200-300 pcphpl.
3. Construction activity close to the live traffic lane. One reference suggests as much as 160 pcphpl less volume when workers and construction equipment are operating right next to the live traffic lane.
4. Lane width less than 12 feet (i.e. an 11-foot lane will reduce capacity by 3%, a 10.5-foot lane will reduce capacity by 5%). Shoulder width less than 6 feet will also reduce capacity of an adjacent lane.
5. High volume of heavy trucks. Each truck is approximately equivalent to 2 cars. Typical heavy truck volume on freeways in Wisconsin is about 20%.

6. Random incidents (i.e. flat tire, patrolman stopped vehicle, crash, gawking at some activity on the side of the road, etc.). In general, if a freeway experiences greater than 25,000 ADT (2-way) and only one lane of traffic is provided in a direction during peak traffic periods, serious traffic delays will result.

Table 30.3 Capacity Calculation

	Site Conditions		Rural	Urban
Choose one	Short-term construction	Start at	1600 pcphpl	1600 pcphpl
	Long-term construction	Start at	1550 w/ crossover (1750 w/o crossover)	1750 pcphpl
Choose any that apply	Close, Intense Construction Activity Proximity (Large number of work vehicles, workers, noise/dust)	Subtract	Up to 160	Up to 160
	Construction Activity Less Intense than Average (Guardrail/barrier installation, pavement repairs at intermittent spot locations, work activity across median)	Add	Up to 160	Up to 160
	11’ lane width	Multiply	0.97	0.97
	10.5’ lane width	Multiply	0.95	0.95
	Shoulder width < 6’	Multiply	0.97	0.97
	Heavy Vehicle/Truck Volume	Multiply	(1-%Truck)	(1-%Truck)
	Onramp within 1500’ downstream of lane closure taper	Subtract	Hourly ramp volume (600 max)	Hourly ramp volume (600 max)

The normal starting point in developing traffic control options is to determine the number of traffic lanes that will be needed to handle the expected traffic demand. Table 30.3 and the factors described above should be used to estimate the capacity of each open lane. This early check of available roadway capacity is critical because the vast majority of additional delay due to a work zone occurs if the traffic demand exceeds the available capacity for any appreciable length of time.

The Highway Capacity Manual 2000 [3], Equation 22-2 can be used to determine the resulting adjusted capacity of the roadway lane:

$Ca = (1{,}600^{*} + I - R) \times fHV \times fLS \times N$

Where

Ca = adjusted mainline capacity (veh/h);

I = adjustment factor for type, intensity, and location of the work activity

(ranges from –160 to +160 pc/h/ln);

R = adjustment for ramps; and

fHV = adjustment for heavy vehicles as defined in HCM Equation 22-1;

fLS = adjustment for lane/shoulder widths;

N = number of lanes open through the short-term work zone

* Assumes starting capacity of 1,600. Use 1,550 or 1,750 where appropriate. Refer to Table 30.3.

30.6 Estimate Hourly Demand Profile (Traffic Volumes)

Volume data is collected using the many automatic traffic recorders (ATR) located on the State Trunk Highway System, which are monitored daily by a telemetry system and inserted into the WisDOT TRADAS program for

further analysis based on time-of-day, day-of-week and year.

If the demand of the chosen roadway segment is within the capacity of the open lanes during the desired dates and times of the lane closure, then the lane closure is appropriate. If the chosen dates and times of the roadway segment are not within capacity during the planned closure time, the user should consider appropriate closure days and times that have lower volumes. When not feasible to choose days and times with lower volumes, queues and delays must be estimated as described later in the procedure. One must take into account data errors in the volume data, and it is recommended to look at an average of similar days and times in case a special event or incident affected the volume data depicted during the analysis period. If no data is available, an adjacent roadway segment may be chosen if they have similar AADTs, surrounding environments and geometric characteristics. One must take into account any entrance or exit ramps that would change the volumes at the segment in question. If the adjacent roadway is not suitable, an overall average of the roadway segment may be sufficient to determine typical volume trends for an average day. The Regional Traffic Engineer should be consulted to provide expertise on demand for roadway segments in the Region.

It can be expected that actual traffic demand during periods of roadwork will be less than during non-roadwork conditions, especially for long-term construction projects and where extensive public information about the work is provided. Factors that may achieve a reduction in demand include the use of automated devices such as highway advisory radio (4-20% reduction in demand) and dynamic message signing (8-25% reduction in demand), and public information campaigns (20-30% reduction in demand in urban areas). Other factors that may reduce demand on a facility are availability of alternate routes, alternate modes, a high percentage of commuter traffic using the facility, or when significant queues are present and traffic is able to divert to another system or alternate route.

Weather also plays an important role in demand calculations. Motorists will adjust to major storms by anticipating them and the hourly distribution will change. Weather will also deter some trips from occurring, but weather will definitely change the capacity of the work zone.

If night work is proposed or considered, see the Night Freeway Work Operations subsection under the Plan & Prepare for Special Conditions section.

30.7 Estimate Queues and Delays Using Appropriate Tools

Work zone capacity can be considered a rather consistent value for the use of macroscopic delay modeling, where travel demand requires a more careful analysis of upstream activities because of advance warning signs notifying drivers of work ahead. Traffic flow changes in many entrance/exit ramps upstream of work zones must be accounted for to effectively predict work zone queue lengths. Observed volume reduction at initial queue development where exits to alternate routes are available ranged from 10 to 30 percent. Additional details are available in the Work Zone Capacity and Analysis Tool (WZCAT) Calibration/Validation [4] report. The report also found that consideration of entrance/exit ramps upstream of the work zone could significantly improve the estimation of delay due to work zone activities. However, this depends on the drivers' knowledge of the downstream traffic conditions and their knowledge of alternate routes.

Results of estimated queues and delays analysis should be compared to the statewide delay guidelines of no more than 15-minute delay above the normal travel time between city nodes and within each city node. Refer to the Corridor Delay map in Attachment 30.2 for the designated city nodes. Research and experience by other transportation agencies has concluded that when a queue length in excess of a mile is sustained for a 30-minute period, the work zone is likely to be unacceptable during that period.

The following software programs are recommended for use in determining queue lengths and delay and are described in more detail below:

1. Work Zone Capacity and Analysis Tool (WZCAT) - For simple projects (typically TMP Type 1, 2 and sometimes 3) that may have smaller work zone lengths or shorter durations, usage of the HCM methodology would be appropriate. The current version of WZCAT uses HCM methodology to calculate delay due to work zone operations based on two inputs. One input is "work zone capacity" which is simply the capacity estimated for the work zone and the second input is demand which is traffic volume usually estimated from a single detector location upstream of the work zone. This tool is limited by the use of only a single detector location, and it does not take into account the impact of heavy vehicles on queue estimations. As a result, the UW Traffic Operations and Safety Lab research report on the WZCAT program offered reduction factors that can be applied to the demand in order to improve the delay estimation provided by the tool. These demand reduction factors are similar to those described in the Estimate Hourly Demand Profile Section of these guidelines.
2. QuickZone - For more intermediate projects (typically TMP Type 2, 3 or 4), the QuickZone program developed through FHWA may be used to estimate travel delay caused by work zones. Users can compare the impacts of construction staging and phasing alternatives, work times, lane closures,

traffic diversions, and various mitigation strategies. The software requires the user to input a fairly large amount of data, including creation of a network of links and nodes which can be time consuming, construction location, times, duration, detour routes, and traffic volumes. The software can then be used to determine vehicle delay and delay costs, queue lengths and construction costs. This additional data input makes the software more appropriate to be used for larger, more complex construction projects. For small single lane or ramp closures, the user will need to decide if the extra capabilities of the software are worth the extra time needed to input the data, compared to some of the other packages and methods.

3. Lane Closure Capacity Analysis Tool (LCAT) - This tool is intended for simple and intermediate projects where their characteristics are within the assumptions made during the simplified analysis. Twenty-four hour, off-peak and nighttime single and dual lane closures results for the different highway segments of the freeways and expressways system are provided for typical spring, summer and fall seasonal traffic volumes grouped in Monday-Thursday, Friday, Saturday and Sunday. Results include vehicle delay and queue lengths for the mainline, speed assessment on alternate routes, and total user delay cost. For more information see http://transportal.cee.wisc.edu/closures/devel/ .
4. Quadro - For intermediate to complex projects (typically TMP type 3 and 4). Similarly to QuickZone, users can compare the impacts of construction staging and phasing alternatives, work times, lane closures, traffic diversions, and various mitigation strategies. This software is the base of the LCAT. For more information visit http://www.wisdot.info/quadro/ .
5. Microsimulation Programs - For larger, more complex projects (typically TMP Type 4), a microsimulation program may be appropriate to determine the extent of queuing and user delays. The Paramics software, developed by Quadstone Limited, is a microscopic stochastic simulation model that is very comprehensive and has the potential for application to a wide set of freeway, arterial, and network situations. Individual vehicles are modeled in fine detail for the duration of their entire trip, providing traffic flow, travel time and congestion information, as well as enabling the modeling of the interface between drivers and ITS. These programs will provide a more detailed analysis, however, the programs require detailed traffic data, and appropriate calibration measures and can take an extensive amount of time to create a working model.

The estimated delay from one of the previously mentioned programs should be compared to the WisDOT standard acceptable delay criteria in Attachment 30.2. If the estimated delay does not exceed the acceptable delay of 15 minutes above the normal travel time between city nodes or within each city node, then the lane closure is appropriate for the days and times depicted. However, if the estimated delay exceeds the acceptable delay, the days and times of lane closure should be adjusted or additional mitigation strategies should be considered and steps 1 through 4 should be repeated.

An example calculation using the HCM method to estimate queue length and delay of a work zone is shown below:

Example:

A maintenance operation will require a closure of the median lane of a three-lane urban freeway segment for a total of seven hours. Work activity will involve a large number of work vehicles close to traffic. Heavy Vehicle/Truck adjustment factor is 0.9. Data obtained from a nearby traffic counter during the previous two weeks were used to estimate the following demand pattern (columns A and B):

Solution:

Determine average capacity of work zone configuration as 1600vphpl – 160vphpl * 0.9 * 2 lanes = 2600vph (1,300 vphpl). (The 160 is subtracted from the capacity to account for the intensity of the activity and multiplied by the truck adjustment factor and number of lanes in work zone as shown in Table 30.3). Late lane merging is used so all three lanes are open upstream of the site, N = 3.

Length of queue, in feet, is determined by L = Qlv/N

Q = number of vehicles in queue at time t;

N = number of open lanes upstream of the site; and

lv = average length of vehicle (30 feet)

A	B	C	D	E	F
Time Period	Volume Anticipated (vph)/ Per Lane Volume (vphpl)	# Vehicles approaching WZ in excess of capacity during the hour	Est. # Vehicles in Queue (assume cap 1,300 vphpl with work zone)	Length of Queue in Feet (miles)	Delay time at back of Queue (min)*
9:00 AM – 10:00 AM	1,920 / 960	0	0	0	0
10:00 AM – 11:00 AM	2,120 / 1,060	0	0	0	0
11:00 AM – 12:00 PM	2,200 / 1,100	0	0	0	0
12:00 PM – 1:00 PM	2,500 / 1,250	0	0	0	0
1:00 PM – 2:00 PM	2,830 / 1,415	230	230	2,300 (0.4)	(230/2,600) * 60 = 5
2:00 PM – 3:00 PM	2,940 / 1,470	340	570	5700 (1.1)	(570/2,600) * 60 = 13
3:00 PM – 4:00 PM	3,620 / 1,810	1,020	1,590	15,900 (3.0)	(1,590/2,600) * 60 = 37
Lane reopened					
4:00 PM – 5:00 PM	4,520 / 2,260	0	0	0	0

* Equation for delay time at back of queue is [Vehicles in queue / Capacity (veh/hr)] * 60 min/hr = minutes of delay.

A queue of 3.0 miles is undesirable and other mitigative options should be considered, such as revising the work hours or reducing the demand volume by providing traveler information to encourage use of alternate routes.

The following thresholds have been created by Ohio DOT and are used for the evaluation of project queue lengths as determined by computer models:

1. For queues less than 0.75 miles, the work zone impacts are acceptable.
2. For queues greater than 0.75 miles and less than 1.5 miles, the work zone impacts are acceptable if the queue exceeds 0.75 miles for two hours or less. Where queues are expected to exceed 0.75 miles for any period of time, additional advanced work zone warning signing should be specified.
3. For queues longer than 0.75 miles for more than two hours or longer than 1.5 miles for any period of time, the work zone impacts are unacceptable. Alternate strategies shall be considered per the provisions of this policy.
4. A vehicle will be considered part of a queue if its average operating speed is approximately 10 mph or less. Discretion is required by DOT personnel during both the analysis portion and field evaluation of the implemented work zone in determining what constitutes a queue. In general a condition that causes driver frustration due to stop and go operations should be considered a queue.

30.8 Identify Appropriate Mitigation Strategies

If congestion and delays are anticipated it is effective and desirable to develop and implement a well planned public information campaign. The public will be more tolerant of delay if they are informed of it in advance, and they may take other routes.

Possible mitigation strategies include but are not limited to:

1. Public information campaign.
2. Develop, sign and advertise alternative routes,
3. Ramp metering or close certain ramps at critical time periods.
4. Use changeable message signs to inform travelers of delay ahead and to consider an alternate route

(messages may be operator-controlled or triggered by portable work zone ITS sensor data).

5. Highway advisory radio (flashing lights on signs when travelers should tune in).
6. Encourage use of alternative travel modes.
7. Temporary pullouts for disabled vehicles.
8. Incident response planning with state, county, local police, and private contracts for towing, pushing, fuel, flat tires, overheating, etc.

See the Estimating Hourly Demand Profile section for discussion of traffic volume reductions that can be expected as result of some of these mitigation strategies.

In areas with higher commuter traffic, it may be beneficial to concentrate mitigation funds on public information campaigns together with signing and possible capacity and operational improvements (i.e. signal timing improvements, turn lane improvements, etc.) on alternate routes that regular commuters will most likely use until construction work is complete on their regular route. On segments with higher volumes of non-commuter traffic, highway advisory radio and changeable message signs may be used in addition to help inform travelers of the work zone ahead and perhaps divert their travel routes.

Other more funding-intensive strategies may be to widen bridges, reconstruct shoulders into driving lanes, or add temporary lanes for bi-directional or single-direction traffic. There are also contracting methods to potentially reduce the total time that will be required for the construction or maintenance operation, which include:

- Lane rental,
- Cost-plus-time bidding,
- Incentives/disincentives, and
- Flexible notice-to-proceed dates

Further information regarding mitigation strategies and how they can be incorporated into a work zone TMP can be found in the WisDOT's Transportation Management Plan, FDM 11-50-5.

30.9 Plan and Prepare for Special Conditions

30.9.1 Emergency Maintenance and Construction Operations

Emergency maintenance and construction operations are inevitable. If emergency maintenance cannot wait until off-peak times, different types of materials and construction methods and equipment that have been identified as reducing lane occupancy during maintenance should be considered. These include very early strength concrete for patching, use of a pavement patching machine, quick drying paint (Fast Dry Acrylic Waterborne applied at 10 mils rather than 15 mils), temporary marking tape and special-purpose mobile equipment such as a device that automatically places and retrieves cones.

The Regional Traffic Engineer or Regional Incident Management Coordinator shall be notified of the emergency maintenance and direct the contractor to follow certain procedures and requirements in order to minimize delay of traffic caused by the closures. The Regional Communications Manager shall also be notified so information can be provided to the media and public.

30.9.2 Night Freeway Work Operations

Whenever high levels of safety, minimal congestion, and access to a work area are not achieved through traditional daytime work zone traffic control and mitigation practices, the feasibility of night work should be evaluated along with other traffic management strategies. It is necessary to have reduced traffic volumes and rapid setup and removal of the traffic control pattern on a nightly basis or there are no advantages to conducting night work. If the construction operation must occupy the roadway for more hours than is provided for night work, or if the temporary traffic pattern requires too great an effort to deploy and remove so that an adequate amount of work cannot be accomplished, no advantage is gained, and normally the night work option should not be considered further.

To enhance the success of night work, the work hours should coincide with the lowest periods of traffic flow and should allow operations to be completed in time for traffic patterns to be returned to daytime conditions prior to the start of the morning peak. Night work can take place any time after the end of the evening peak and last prior to the start of the morning peak. Effective public information efforts are also essential to keep motorists and residents informed regarding traffic plans and impacts on the community. Finally, it must be ensured that materials, equipment, repairs, supervision, and special support services can all be obtained at night as necessary to support the work activities.

Advantages of night work

- Construction cost increases may be offset by increased productivity and decreased highway user costs.
- Reduced interference from traffic increases productivity and can benefit worker safety
- Longer work shifts at night may increase productivity
- Cooler night temperatures may enhance the quality of concrete placed and finished at night
- Driver anger, frustration, and vehicle operating costs may be reduced because of fewer traffic delays
- Fuel consumption and air quality is improved with night work because vehicle emissions are typically reduced because of reduced congestion, shorter delays, and fewer stops.

Disadvantages of night work

- Construction costs are typically more expensive (15-20% increase) because of overtime and night-premium pay, extra lighting expense where needed, added traffic control costs, and increased material costs.
- Reduced visibility and potentially greater difficulty communicating with supervisors and/or technical support staff
- Longer setup/takedown times for traffic controls and lighting
- Motorist fatigue and impairment is a greater concern at night. Workers may be less alert during long nighttime work hours.
- Community concerns associated with night work include noise, glare from work lights, and changes in traffic patterns that impact residential neighborhoods.

Recommendations for enhanced safety in work zones can be found in NCHRP Report 476 “Guidelines for Design and Operation of Nighttime Traffic Control for Highway Maintenance and Construction” at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_476.pdf Chapter 2 of the report illustrates design requirements for various traffic control devices and safety features, highlighting the use of channelizing and guiding devices, fixed signing, changeable message signs, arrow panels, flagging operations, vehicle protection, worker protection and lighting requirements.

30.9.3 Cost Analysis

While this cost analysis is offered as a method to choose among alternative solutions to a single construction or maintenance problem, it must be noted that this analysis is only an aid to the decision-making process and does not replace past experiences and engineering judgment. A worksheet similar to that shown in Table 30.4 should be used to identify as many costs as accurately as possible. Although this method can be used to compare more than one option, it is especially helpful to determine the cost differences between daytime and nighttime work.

Table 30.4 Sample Cost Identification Worksheet

Objective	Factor	Cost		
		Option 1	Option 2	Option 3
Traffic Control	Setup/Takedown			
	Device Costs			
	Maintenance			
	Pedestrian Accommodation			
	Enforcement			
	Detour/Alternate Route Upgrade			
Lighting	Planning			
	Hardware Costs			
	Installation			
	Maintenance			
Constructability	Labor			
	Labor Premiums			
	Incentive Clauses			
	Materials			
	Equipment			
User	Traffic Delay Costs			
	Vehicle Operating Costs			

References

[1] Wisconsin Department of Transportation, “Guidelines for Developing Work Zone Transportation Management Plans.” February 14, 2007 Draft.

[2] The Final Rule on Work Zone Safety and Mobility was published on September 9, 2004 in the Federal Register; http://www.ops.fhwa.dot.gov/wz/resources/final_rule.htm

[3] Highway Capacity Manual 2000, Transportation Research Board, 2000.

[4] Lee, Chanyoung and Noyce, David A, “Work Zone Capacity and Analysis Tool (WZCAT) Calibration/Validation.” January 2007 Draft.

LIST OF ATTACHMENTS

Attachment 30.1 Lane Closure Analysis Process

Attachment 30.2 Corridor Delay Map

FDM 11-50-35 Concrete Barrier Temporary Precast in Work Zone *December 3, 2008*

35.1 Introduction

The following procedure establishes design guidelines for the use of Concrete Barrier Temporary Precast (CBTP). CBTP is effective in providing positive separation between traffic and the work area. When used appropriately, CBTP has the potential to reduce the severity of crashes. However, the CBTP itself and the proximity of the end of the CBTP can also be a hazard to traffic. Whenever feasible, it is preferable to remove the hazard and avoid the need for CBTP. Typical reasons for use of CBTP are:

- To separate high-speed vehicular traffic from the work area, especially at locations that place workers at increased risk from motorized traffic,
- To shield a hazard,
- To protect vehicles from embankments or drop-offs,
- To separate opposing directions of traffic.

35.2 Factors to Consider

In this procedure, situations are listed that would typically justify CBTP. However, each project has a unique set of factors that should be considered. These factors include:

1. Speed and volume of traffic,
2. Vertical and horizontal alignment of the roadway,
3. Severity of the hazard, obstacle, or dropoff/slope adjacent to the roadway,
4. Lateral clearance to the hazard, obstacle, or dropoff/slope,
5. Duration of exposure to the hazard,
6. Nature of the work zone (e.g., whether it is a stationary work zone, at a spot location, or a moving work zone),
7. Hazard that would be presented by the barrier itself and by the barrier installation and removal activity.

For example, greater lateral clearance to a hazard results in a lesser need to shield the hazard with CBTP. Where a range of distances for the desired lateral clearance is listed in this procedure, consider factors such as traffic speed/volume and duration of exposure to determine appropriate lateral clearance for a project, and whether CBTP should be used.

35.3 Guidelines for CBTP Use

If the work area closure is anticipated to last more than three continuous days and nights without a change to the traffic control layout or staging, CBTP is recommended for the following situations:

1. A bridge deck or culvert replacement/rehabilitation where any of the following conditions is anticipated to exist for more than three consecutive days and nights:
   - Full-depth holes in the deck,
   - Railing removed,
   - Confined/restricted work area.
2. Dropping/removing a bridge deck over roadway if the work activity is more than three consecutive days and nights.
3. A bridge painting project over the roadway.
4. To separate counter directional traffic where two or more lanes in each direction are provided during the work and posted speed limit >= 45 mph.

   Depending on the significance of the factors listed at the beginning of this procedure, other common situations which may justify CBTP, include:

   A. Spot (or isolated) locations where the work area closure will last for more than three continuous days and nights without a change to the traffic control layout or staging, and either of the following conditions is anticipated:
      - Exposed hazard that is at the same spot for more than three consecutive days and nights and is closer to an open traffic lane than:
        1. 15 - 20 feet on freeway or expressway,
        2. 10 - 15 feet on non-freeway/expressway where the posted speed limit is >= 45 mph,
        3. 8 - 10 feet if AADT is less than 1,500 or the posted speed limit is less than 45 mph.
      - Examples include footings, abutments, and construction activities such as false work.

      The distance between the edge of the open traffic lane and the work is less than 6 feet (4 feet if non freeway/expressway) and the work is anticipated to continue for more than three consecutive days and nights at the same spot location.

If the work area closure and hazard will last for extended length of time (e.g., more than 2 months), lateral clearance should be greater than noted above, or CBTP should be considered.

Whenever feasible, it is preferable to remove the hazard and avoid the need for CBTP. Where the hazard cannot be removed, an option in lieu of CBTP to shield some hazards is to use attenuators, or crash cushions as described in FDM 11-45-1.

B. Where a dropoff or slope steeper than 3:1 is anticipated to exist for more than three continuous days and nights, has a continuous length of 100 feet or more, and is close enough to a traffic lane that the likelihood of vehicles going off the edge of the road are significant (See Table 35.1).

Table 35.1 Drop-offs to Commonly Justify CBTP

	Freeways/ Expressways 60 – 65 mph	**Freeways/ Expressways 45 – 55 mph**	**Non Freeways/ Expressways 45 – 55 mph**
Depth of Drop off (in)	Lateral Offset (ft)*	Lateral Offset (ft)*	Lateral Offset (ft)*
6 – 12	0-2	0-2	0-2
13 – 24	0-4	0-4	0-4
25 – 36	0-12	0-8	0-4
> 37	0-20	0-20	0-8

* For dropoffs on the outside of a horizontal curve or taper, or where the dropoff will last for extended length of time (e.g., more than 2 months), provide greater offset than shown in the table. Otherwise, consider CBTP. Whenever feasible, provide a minimum 2-foot lateral offset between the edge of the traffic lane and any dropoff. Where this is not feasible, a maximum dropoff of 6 inches may be acceptable without using CBTP. Provide a sloped edge of aggregate or other temporary fill material at the dropoff.

For roadways with posted speed limit, less than 45 mph consider the factors listed in the beginning of this procedure to determine if a barrier is warranted.

The need for CBTP to protect from drop-offs may be avoided by using aggregate or other temporary fill material to increase the lateral offset and/or to provide a 3:1 or flatter slope adjacent to the pavement or shoulder. Even if adequate lateral offset is provided, a sloped edge is desirable. Provision of temporary fill material at the pavement edge should be specified on Construction Details in the plan.

C. At freeway/expressway crossover entrances to prevent vehicles from entering opposing traffic lanes (as shown on SDD 15D5). CBTP should also be considered at crossover exits that will be in place for more than one week, as shown on SDD 15D10 where AADT is >=20,000.

D. Other situations where a combination of severity of hazard, high traffic volume, geometric concerns, and/or long duration of exposure exist.

35.4 CBTP Anchoring Requirement/Deflection Distance

Although CBTP is designed to prevent an errant vehicle from entering a construction work zone, research tests have shown lateral deflection of the barrier after a vehicular hit. The barrier shall be anchored if the distance to a 2 foot or greater dropoff is steeper than 3H : 1V, and:

1. The posted speed is 45 mph or greater and the dropoff is less than 4 feet from the side of the barrier closest to the dropoff,
2. The posted speed is 40 mph or less and the dropoff is less than 2 feet from the side of the barrier closest to the dropoff.

For example, the edge of a bridge deck or a dropoff at the edge of pavement.

The values shown below are recommended buffer space behind a freestanding concrete barrier installation. Refer to SDD 14B7 for additional guidance.

When shielding hazards above ground:

Posted Speed	Deflection Distance
40 mph or less	2 ft
45 mph or greater	4 ft

When shielding Drop-offs:

Posted Speed	Deflection Distance
40 mph or less	2 ft
45 mph or greater - Vertical Drop-off 6” or less and no traffic below - Vertical drop-offs greater than 6”	 2 ft 4 ft

When used as a Temporary Median Barrier separating opposing traffic lanes:

Posted Speed	Deflection/Shy Distance
40 mph or less	0 ft minimum but 2 ft preferred
45 mph or greater	1 ft minimum but 2 ft preferred

Where lateral displacement of the barrier cannot be tolerated, anchor the barrier to the underlying pavement surface according to the details in SDD 14B7.

35.5 Intersection Sight Distance

When specifying the need for CBTP, it is recommended that the designer check all side road approaches to ensure the CBTP does not restrict intersection sight distance. This is especially critical when the roadway segment has horizontal and vertical curves that may further affect sight distance. Provide appropriate turning radii in urban areas to accommodate school buses and other large vehicles. Install portable crash cushions so the end of the cushion is located at least 50 ft from the intersecting side road. The intersection may need grading to minimize drop-offs

35.6 CBTP End Treatments

35.6.1 Clear zone

For the purpose of determining the need for end treatment for temporary precast concrete barrier in work zones, the following clear zones are appropriate. Where a range of minimum to desirable clear zone is noted, consider traffic volume, speed, and duration of exposure to determine appropriate clear zone for the project. For stage switches and short-term work operations of no more than 24 hours duration, lesser clear zone than the minimum noted may be allowed. For end treatment barrier installations in place for extended length of time (e.g., more than 2 months), a greater clear zone should be considered.

- Freeways and expressways: 15’ minimum, 20’ desirable.
- Other highways (non-freeway/expressway): 10’ minimum, 15’ desirable.
- Other highways with AADT less than 1500 or non-construction speed limit of 45 mph or less: 8’ minimum, 10’ desirable.
- Bridge projects with temporary traffic signals, one open lane shared by both directions: 12’ from the open traffic lane.

35.6.2 Barrier Flare

The most desirable treatment for the exposed end of CBTP is to flare the barrier away from open traffic lanes to the edge of the clear zone as defined above. Cost effective flare rates range from 4:1 (low speed roadways) to

8:1 (high speed roadways). Longer flare rates increase the number of impacts while shorter flare rates increase the severity of crashes. For additional guidance, refer to Roadside Design Guide. The recommended flare rates are shown below.

- 8:1 for operating speed of 45 mph or more.
- 6:1 for operating speed of 40 mph or less.

Often it is not possible to flare the barrier to the edge of clear zone due to space limitations or need for construction vehicles and equipment to access the work area. If the barrier is not flared to the edge of clear zone and speeds are 35 mph or greater, temporary grading may be required for uneven ditch sections or NCHRP Report 350 Test Level 3 approved sand barrels or portable crash cushion should be provided as the barrier end treatment. The Roadside Design Guide contains recommended barrier end placement examples in non-level shoulders and medians.

35.6.3 Construction Work Operations and Traffic Stage Switches Near Flared Barrier

Even if the barrier is flared away from traffic, the barrier may have to be straightened and the barrier end moved closer to traffic to complete some work operations and traffic stage switches. If the barrier end would be located within the clear zone for longer than 24 hours and speeds are 35 mph or greater, one of the following treatments should be done:

1. Provide a portable crash cushion,
2. Taper traffic to the shoulder or adjacent lane to provide more lateral clearance to the barrier end,
3. Remove the barrier and stockpile it off the work site.

35.6.4 Crash Cushion or Sand Barrels.

As indicated earlier in this procedure, if it is not possible to flare the barrier to the edge of the clear zone and speeds are 35 mph or greater, then NCHRP Report 350 Test Level 3 approved portable crash cushion or sand barrels should be provided as the barrier end treatment. Install an approved crash cushion or sand barrels on the exposed end of the barrier if within the clear zone. These end treatments are designed to absorb energy of an impacting vehicle by reducing the impact force to acceptable levels. A crash cushion or sand barrels are required on the upstream end for divided or one-way facilities, and on both ends for all two-way facilities, including temporary two-way facilities, such as in freeway counter-directional operations. The types of crash cushions currently used are listed in the WisDOT Approved Products List.

Sand Barrels consist of a group of free-standing barrels and are discussed in FDM 11-45-1. When selecting the crash cushion or sand barrels, consider the frequency of nuisance hits.

FDM 11-50-40 Law Enforcement in Work Zones

December 22, 2011

40.1 General

Excessive speeds in highway construction work zones can adversely affect the safety of the work force and the motorists. There are a number of methods for slowing traffic to acceptable speeds in work zones, including flagging, regulatory and advisory signing, changeable message signs, flashing lights, lane width reductions, law enforcement, etc. Past experience has shown that law enforcement techniques are effective in reducing speeds in work zones and provide valuable assistance in removing disabled vehicles from the roadway. Law enforcement activities can be in the form of:

- Stationary Patrol Cars
- Police Traffic Controller (Officer does flagging)
- Circulating Patrol Car
- Stationary Patrol Car - Lights On
- Stationary Patrol Car - Radar On
- Freeway Service Team Support

On any construction project, the method of constructing the project and the method of handling traffic should be resolved early in the project development process. The following guidelines are presented to assist the designer in identifying when specialized law enforcement techniques might be warranted.

40.2 Type of Facility

Generally use of law enforcement officials on a continuing basis is warranted only on freeways or Interstate roadways where traffic volumes are in excess of 25,000 - 30,000 AADT and lanes are closed in peak periods. Where lane closures are limited to off-peak periods, a higher AADT (approximately 35,000) is typically

considered a minimum threshold volume to justify extra law enforcement. Reduction of work zone traffic speeds requires the existence of an enforceable speed limit. If the desirable speed is less than the legal posted speed than the speed limit must be lowered. The State Traffic Engineer has the authority to reduce the legal speed limit by up to 10 mph on State Trunk Highways. Designers should work with their Region Traffic Sections to determine if the speed limit should be reduced and to establish a temporary speed zone declaration.

40.3 Type of Work

Construction projects considered for law enforcement techniques should involve a concentrated work effort over major segments of the project. If actual construction is not visible, credibility of the work zone speed reduction is questioned, thereby reducing its effectiveness. Also, to be effective, the construction work must allow space for law enforcement officials to stop violators at the point of infraction. If sufficient shoulder area does not exist, consideration should be given to the construction of temporary "pull-off" areas.

These guidelines are intended for the long term contractual type law enforcement activities. They are not intended to limit the short term use of law enforcement agencies for construction control on applications such as lane closures, traffic lane switching, etc. Proposed use of law enforcement techniques shall be included in the TMP.

40.4 Support Services for Work Zone Mitigation

Refer to TGN 6-3-5 Law Enforcement Mitigation for further assistance on determining when to use law enforcement support for work zones.

FDM 11-50-45 Pavement Marking

August 14, 2008

All guidance concerning pavement marking has been transferred to WisDOT's "Traffic Guidelines Manual" or TGM.

WisDOT staff can access this manual by going to:

http://dotnet/dtid_bho/extranet/manuals/tgm/index.shtm and click on Chapter 3.

Non-WisDOT readers can access this manual by going to:

https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/manuals/tgm/index.shtm and clicking on Chapter 3.

Non-WisDOT staff must first establish an account on the department's extranet before they can access the TGM. To do this go to http://on.wisconsin.gov then click on "Self-Registration" and follow the instructions.

FDM 11-50-50 Signals

December 22, 2011

50.1 General

Control devices in this category include traffic and pedestrian control signals, beacons, lane use control signals, lift bridge and swing bridge signals and gates, emergency traffic control signals, and railroad crossing signals and gates, all of which are either pre-timed or traffic actuated.

50.2 Traffic Signal Investigation

As part of the scoping process for a highway improvement project, the designer must consider whether traffic signals are anticipated within the project design life. If signals are currently located within the project area, it is very likely that signal operations/controls will require modification and updating.

Table 50.1 and Table 50.2 are NOT signal warrants, but are a guide for determining if special intersection treatments or signals may be needed within the design life of the project. If the current or projected volumes come close to or exceed the suggested minimum threshold AADT volumes on both the major and the minor street listed in Table 50.1 or Table 50.2, notify the region traffic personnel that special intersection treatment or safety improvements may be needed. Case 1 is related to the volume of intersecting traffic through-put of an intersection. Case 2 is related to the lack of gaps, or continuous traffic, on the major street that may cause excessive delay on the minor street.

Table 50.1 should be used when the 85th percentile or posted speed exceeds 40 mph, or when the intersection lies in an area having a population of less than 10,000. Table 50.2 should be used in conjunction with facilities not covered by Table 50.1. When the traffic volumes are approached or exceeded in the following tables, the traffic section will evaluate possible solutions such as: The need for a four-way stop, improved signing, geometric changes, traffic signals, roundabouts or other improvements.

Table 50.1 Minimum Threshold Traffic Volumes for Case 1 & 2 (typically rural) 1

Lanes per Approach		Case 1		Case 2	
Major St.	Minor St.	Major St. (2-way ADT)	Minor St. (2-way ADT)	Major St. (2-way ADT)	Minor St. (2-way ADT)
1	1	5,600	3,400	8,400	1,700
2	1	6,700	3,400	10,100	1,700

[1] ITE, Manual of Traffic Signal Design, 1982, p18

Table 50.2 Minimum Threshold Traffic Volumes for Case 1 & 2 (typically urban) 1

Lanes per Approach		Case 1		Case 2	
Major St.	Minor St.	Major St. (2-way ADT)	Minor St. (2-way ADT)	Major St. (2-way ADT)	Minor St. (2-way ADT)
1	1	8,000	4,800	12,000	2,400
2	1	9,600	4,800	14,400	2,400

[1] ITE, Manual of Traffic Signal Design, 1982, p18

Region traffic personnel will evaluate the intersection for meeting various traffic signal warrants. The designer may have to provide information to the traffic personnel on the proposed design such as: adjacent parking, bus pullout bays, approach grades, lane widths, number of lanes, speed, percent trucks, design hour volumes, turning movement volumes and intersection layout showing access and sight distance. Part IV, Section C of the Manual on Uniform Traffic Control Devices (MUTCD) shows a complete list of the traffic signal warrants.

Traffic control signals should not be installed unless one or more of the traffic signal warrants are met. The satisfaction of a warrant or warrants is not in itself justification for a signal. If signals are to be installed on portions of the State Trunk System or on connecting highways, a region traffic engineer must submit a recommendation on the matter (form DT1199 and Signal Investigation Report, also see the Traffic Signal Design Manual) for approval by the State Traffic Engineer before the signals may be incorporated into the project.

50.3 Design Standards

The design of traffic signal systems shall conform to the Department's "Traffic Signal Design Manual." Contact the person named below for information on how to obtain this manual.

State Traffic Signal Systems Engineer
Bureau of Traffic Operations, Rm 501
P. O. Box 7986
Madison, WI 53707-7986
(608) 261-5845

This manual is also available on the dotnet for WisDOT staff and on the extranet for non-WisDOT staff.

FDM 11-50-55 Signing

August 14, 2008

55.1 General

Signs are essential when special regulations apply at specific places or at specific times only, or when hazards are not self-evident. They also provide information concerning highway routes, directions, destinations, and points of interest. Signs are classified in accordance with their basic function as either regulatory, warning, or guide signs. For a detailed description of the various types, the reader is referred to the Wisconsin Manual of Traffic Control Devices (WMTCD).

The basic requirements of a street or highway sign are that it be legible to those using it and that it be understood in sufficient time to permit a proper response. This requires a high degree of visibility, lettering and/or symbols of adequate size, and a brief legend for quick comprehension by the approaching driver. Standardized colors and shapes are specified so that the several classes of signs can be promptly recognized. Simplicity and uniformity in design, position, and application are important and necessary considerations in this

regard.

Each standard sign should be displayed only for the specific purposes as prescribed in the WMTCD. Before any new or reconstructed highway, temporary route or detour is opened to traffic all necessary signing should be in place. Signs required by road conditions or restrictions should be removed when those conditions are no longer present or the restrictions are removed. Uniformity of application is as important as standardization with respect to design and placement. Identical conditions should always be marked with the same type of sign irrespective of where those particular conditions occur.

55.2 Reflective Sheeting For Highway Signs

All types of reflectorized signs on state and local projects administered by WisDOT shall have standard reflective sheeting backgrounds regardless of whether or not federal funds are used to finance the signing, except that Type H (higher reflectivity) material shall be specified for the background material for the following applications:

1. Signs having a reflective red background, i.e., STOP, YIELD, WRONG WAY, DO NOT ENTER, etc.
2. Clearance markers and One-Lane Bridge signs.
3. Guide or other signs that are mounted over the roadway when fixed source lighting is not provided.
4. Guide signs on freeways and expressways that have "large, green backgrounds, except motorist services signing, exit, river, lake, county line, mile posts, and other similar signs.
5. Route markers mounted on large guide signs.

Standard reflective sheeting (engineer grade) shall be used for all other reflectorized signs, including green direction signs on which Standard Silver White No. 2 material will be used for the message elements and also including the green background on the guide signs, which are included in the exception to application No. 4 above.

Acrylic plastic button copy in aluminum frames shall be used for the message elements on the large guide signs. Type H reflective material will not be permitted as an equal alternate to the acrylic plastic buttons.

Reflective sheeting with the same durability but lower reflectivity than Standard may be used for parking or similar signs where reflectivity is not a critical consideration.

Use of Type H material other than as described will require detailed justification and Central Office Traffic Section approval prior to submittal of the P.S. & E.

Local governments may specify the Type H material other than as described and without justification if they are willing to pay the additional costs above the Standard material.

FDM 11-50-60 Lighting

August 14, 2008

60.1 General

WisDOT has taken a somewhat conservative approach to the use of lighting, primarily because of the high cost of installation, coupled with the long-term maintenance and energy expenditures involved. The lighting of individual intersections, interchanges, etc., is generally discouraged unless it can be conclusively proven that the lack of illumination is the cause of the accidents/confusion at the site and the installation of lighting is the only remedy. If the site is located in a remote area, a potentially dangerous situation can result wherein the driver is subjected to a rapid transition from dark to well-lighted and then back to dark surroundings. For this reason, if lighting is to be installed, continuous lighting is preferred. The Milwaukee area freeways are a typical example of such installations.

Local units that are insistent upon our providing the lighting for various locations can be accommodated and the lighting included as part of the construction contract if the local unit will pay for the installation and all future maintenance and energy costs involved. WisDOT does make provisions for the lighting of major bridges in communities by installing necessary conduit, etc., during construction of the bridge. However, lighting of such bridges is the responsibility of the community, and all costs relating to installation, maintenance, and operation must be assumed by them.

A related topic concerns the use of breakaway supports for lighting installations as well as for signs and traffic signals. WisDOT has adopted the 1985 AASHTO Standard Specifications on the subject, which delineate requirements for the usage and design of such devices. The primary criterion of breakaway supports is that they allow the luminaire, sign, or signal to be safely displaced by a vehicle impact (from any possible direction and/or by any portion of the vehicle) without hazardous intrusion into the passenger compartment or causing a more

serious accident (such as overturning the vehicle or directing it back into traffic, etc.).

Various release mechanisms have been developed, utilizing slip planes, plastic hinges, fracture elements, and combinations thereof. Since product costs vary considerably, contact the Central Office Traffic Section in this regard. For installations within the clear zone (as well as for those beyond the clear zone, where the need exists), the designer should employ the least hazardous breakaway support that can be economically obtained.